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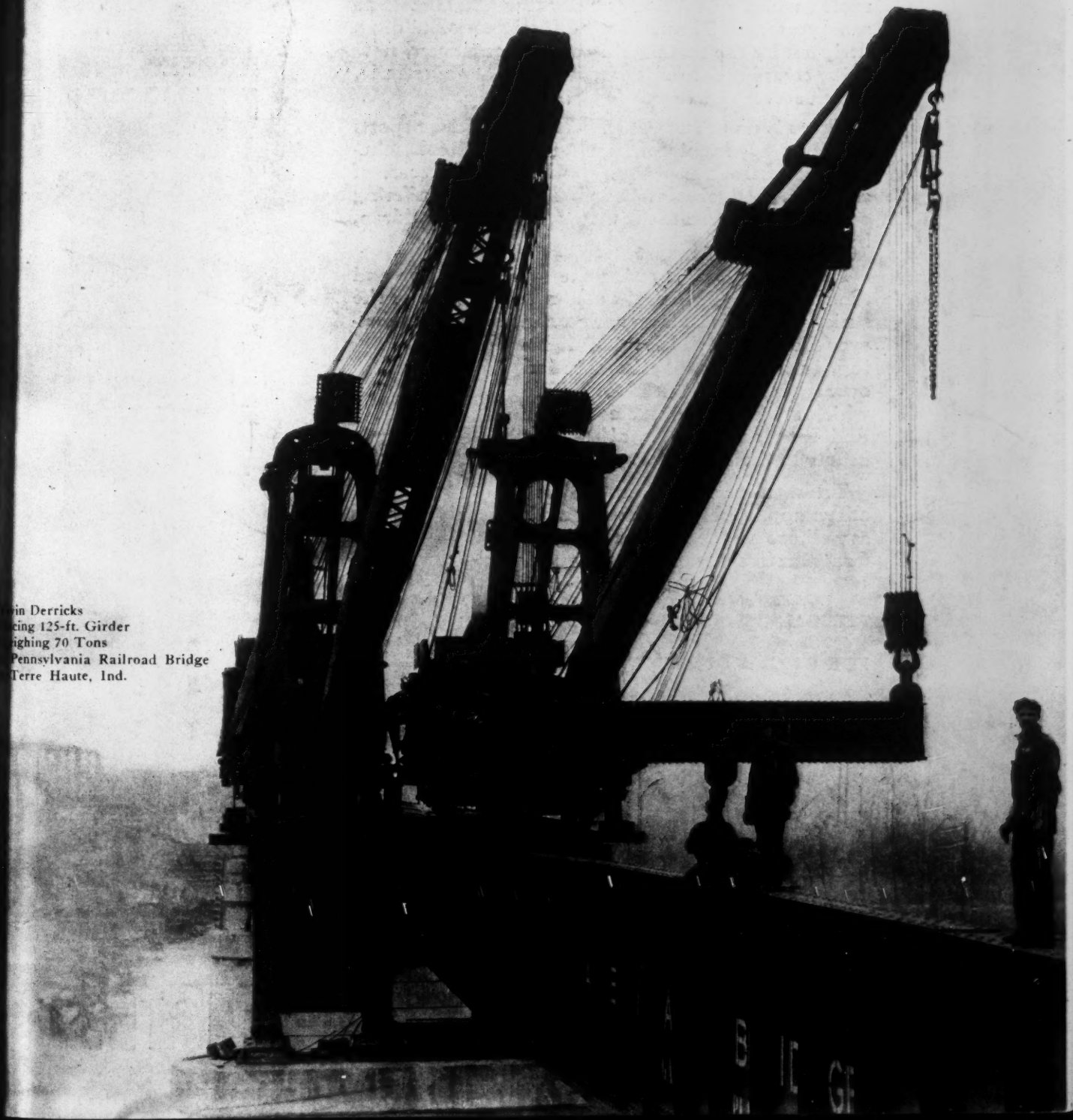

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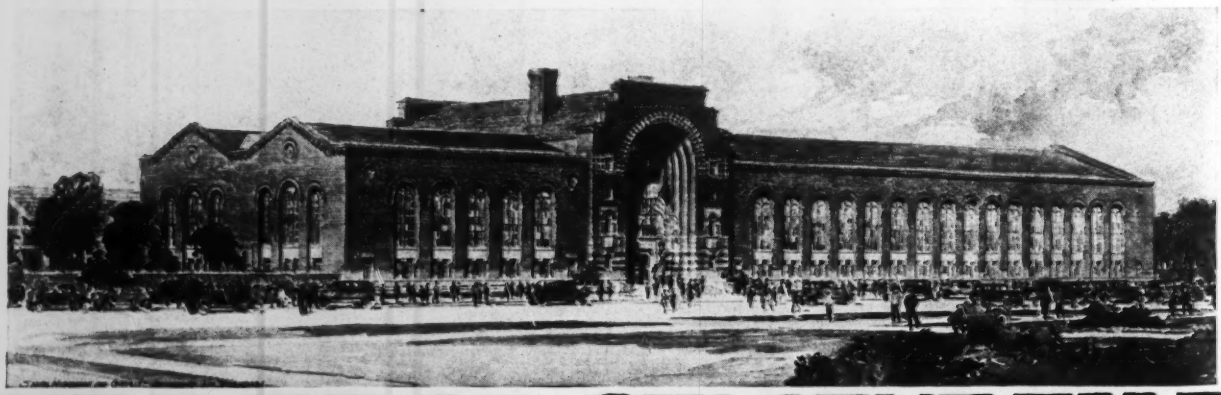

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New York, December 6, 1928

Engineering News-Record

A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

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NEW YORK District Office, 285 Madison Avenue
WASHINGTON, National Press Building
CHICAGO, 7 South Dearborn Street
PHILADELPHIA, 1600 Arch Street
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(*Published in San Francisco*)
American Machinist—European Edition
(*Published in London*)

SUBSCRIPTION PRICES: United States and its possessions, Canada, Mexico, and other countries taking domestic postage rates, $5 a year. All other foreign countries, $9 a year. Single copy, 25 cents. Published weekly. Entered as second class matter, April 11, 1917, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

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Construction Market Place, 172 — Searchlight Section, 151 — Index to Advertisers, 180 — Directory of Consulting Engineers, 147

Number of Copies Printed This Issue, 31,810

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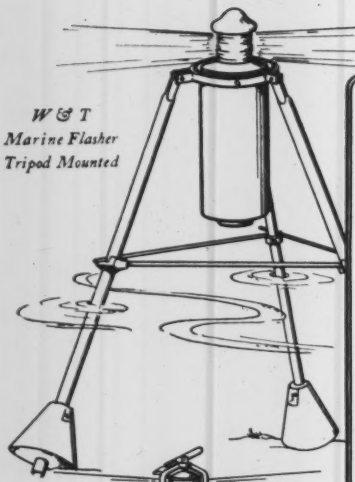

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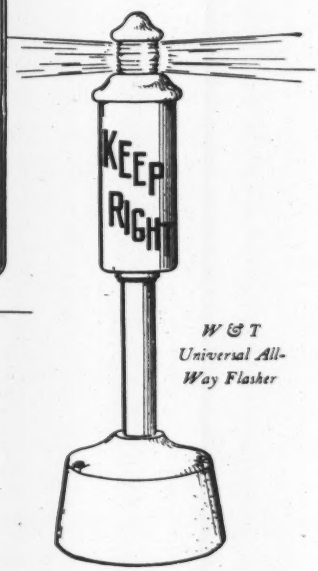

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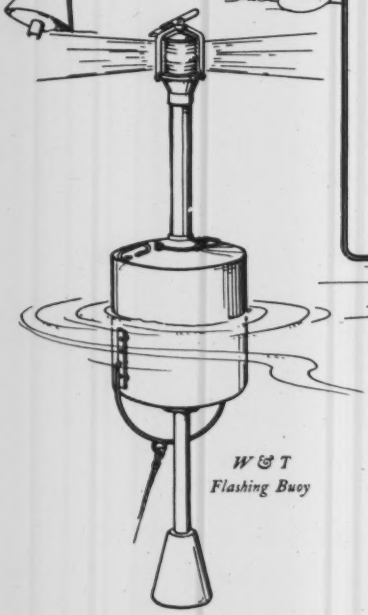

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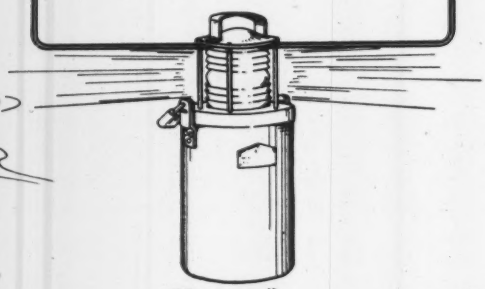

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Volume 101 NEW YORK, DECEMBER 6, 1928 Number 23

Two Great Problems

THE short three months' session of Congress beginning this week will bring some intricate questions into the field of active discussion. Of those which touch engineering matters, two are of first magnitude, the Colorado River problem and Mississippi flood control. The former, as represented by the Boulder dam storage project, has been much clarified through the report of the board of engineers and geologists which last summer reviewed certain main aspects of the project. The board finds that the project is feasible from an engineering standpoint, and by this pronouncement it lays many ghosts which were conjured up in the course of the confused discussions of the past few years. The report does not answer all the economic objections that have been offered, but it helps to put them in such light that Congress should find little difficulty in dealing with them. On the second great question, Mississippi River flood control and stabilization, no new information is presented. Since many other questions of pressing nature will occupy the time of the short session, it is likely that no thorough discussion of the Mississippi can develop before March 4 brings the Congress to an end. Whether or no, however, the river-control work now current and that which is to be put under contract during the coming season will remain unaffected.

Productive Research

FEW instances of the value of pure research to industry are more striking than that given by the Western Union Telegraph Company's attempt to find a wood preservative more suitable for its purposes than those heretofore in common use. By rejecting all accepted theories as to what were the fundamental requirements of a wood preservative, a chemist working in the laboratory of the telegraph company built up a quite different theory—a theory which subsequently was verified by independent research abroad—and thereby made available an entirely new group of toxic substances for use in treating timber to check decay. From this group of substances those which could be produced commercially were selected and by a process of elimination zinc meta-arsenite was determined upon as being the most desirable. Not only does this compound fulfill the requirement of the telegraph company of having no effect upon the electrical conductivity and the strength of timber but also it has the advantage of not being limited in supply, as is creosote, now so widely used as a preservative. Of course, the use of zinc meta-arsenite as a preservative is of too recent application to permit of judging of its full value over a period of years, but accelerated tests indicate that its effectiveness will be of long duration. If such is found to be the case after further years of testing, a much wider field of usefulness in the preservation of wood will be opened up for it, because its character is such that wood treated with it is left with clean surfaces which can be handled and painted like ordinary timber. For this reason, wood treated with this preservative can be used in building and other structures where wood treated with oily compounds now in general use cannot be employed. Thus research has again added new knowledge of value far in excess of its cost.

Fast Winter Work

BUT a few years ago so large a construction job as that involved in the foundation work for the Detroit suspension bridge would have been a most formidable undertaking, one sure to extend over several working seasons at least. As is most interestingly recounted on another page, the Detroit work was carried out in a single season in spite of unusual construction difficulties. It represents an outstanding example of the careful planning and far-reaching co-ordination essential to the task set before the modern constructor. The Detroit work, moreover, was done almost wholly during winter, and thus affords a further demonstration of progress in overcoming the old-time notion that building or heavy civil engineering construction is limited to summer and to fair weather conditions. The machinery, methods and skill available today can cope with low temperatures, freezing and ice in remarkably efficient manner. By virtue of this fact, the foundations, begun a year ago last September, were ready for tower steel by early spring, cable-spinning began in July, and the cables are now completed. Future development will undoubtedly bring further advance in speed of work, perhaps as great as those which separate today's performances from the work of a quarter century ago; offhand, however, it is difficult to foresee just how this advance will be accomplished in view of past achievement.

A Federal-Aid Duty

THE resolution favoring extra federal aid for road-building in the public-land states, which was passed last week in convention in Chicago by the Association of State Highway Officials, serves to call attention again to a necessary act of justice by Congress. At its last session Congress recognized its obligations by making an extra appropriation, about $3,500,000 a year for three years, for federal-aid roads in the eleven Rocky Mountain and Pacific states where there remain large areas of government land. This appropriation act was vetoed by the President, was passed over his veto by the Senate but failed of second passage in the House. Nothing further need be said here of past history nor of the public-land acreages which burden those Western states. The large areas of government lands, which the states cannot tax and the resources of which they cannot develop and utilize, are crossed and recrossed by the roads of the federal-aid and state systems, the construction of which is being pressed by the federal-aid road officials and is indeed essential to the completion of cross-state and interstate through routes. With the present state funds and federal-aid allotments the completion of these routes will

require from fourteen years in some states to more than forty years in others; no such delay can be contemplated with satisfaction. Traffic between states, the development of state lands separated by government reservations and the orderly creation of the national system of roads which has been planned call for prompt construction. It has to be provided for by extra federal-aid appropriations. The obligation, too, is one of justice as well as of transportation business expediency: It is not to the credit of the nation that it shall demand improvement of its land by state-built roads and deny the states both aid in financing construction and utilization of the land improved.

Capacity and Congestion

MUCH modern discussion of traffic capacity appears to assume that capacity is correctly measured during a period of heaviest traffic demand. The assumption is based on incomplete reasoning, we believe. All experience shows that with increasing traffic a point is reached when the volume of flow begins to decrease, until finally congestion supervenes and movement takes place only with serious difficulty. This can and does happen in rapid-transit, in railway, in street and in road service alike. Yet these well-known experiences are often forgotten, and conclusions are drawn from crowded conditions which have no validity when the degree of crowding is kept under control. Only recently some estimates of road-traffic speeds and maximum capacities were put forward which had been derived wholly from study of crowded conditions—and which undoubtedly would have led to different conclusions if the study had been carried on under slightly greater or slightly less degree of crowding. The only conclusions which can be of value are those derived from normal capacities and needs, since the choking effect of congestion is without limit and knows no rule. The planning of traffic improvements and new facilities, therefore, cannot soundly be based on observations on rates of flow during congestion.

Sludge as a Fertilizer

JUST why sewage sludge has never been widely used as a fertilizer, why it is not sought after instead of being a drug on the market, has long been a problem to those who find themselves burdened with the large quantities of it which accumulate at most sewage works. Except in a few instances, attempts to dispose of it to farmers and truck gardeners for fertilizing their crops have been unsuccessful. To develop accurate information as to the value of sludge as a plant food, under control methods that would appeal to farmers, experiments were begun five years ago at Baltimore in co-operation with the agricultural department of the University of Maryland. While the results, set forth on another page, have too many limitations to be conclusive, they indicate that sludge has very definite advantages as a plant food for some crops, such as corn, while other crops do not respond to it as well as to other fertilizers. Also, it was found that sludge is not detrimental to the land, as had been supposed by some. Experiments of this character should be of even greater value if carried out on larger areas, over longer times, and under the soil and climatic conditions of other parts of the country. Once farmers are assured that sludge has a definite fertilizer value for certain crops, they may be expected to find means to cope with the problem of handling the bulky and otherwise awkward material, a problem which to some extent is in part responsible for its neglect.

New Activities

BY AN overwhelming vote the American Society of Civil Engineers has reversed the attitude which it took on several prior occasions and has decided to join the American Engineering Council—subject only to some minor conditions which in all probability will soon be met. It thus breaks definitely with tradition and sets a new milestone in its more than half-century of history. Joining with other major engineering societies for public-affairs service, it will take its place in the formation of a nation-wide guild, a unified public representative of the whole range of activities which correlate the engineer's functions with the requirements of present-day life. Engineering thereby is caused to share in the great movement of centralization which has been in progress for some decades and which is reflected in related fields by the noteworthy growth of trade and industrial associations.

The new professional unification contains large potentialities. If it succeeds in expressing truly the thought and knowledge of the entire constituent membership and bringing them to bear on national action, it will be a force of most powerful effect. In an era of pre-eminently technical problems it can form a new type of fourth estate—a profoundly important development.

Correspondingly, the society assumes peculiarly heavy responsibilities by its present decision. How fully the union will achieve its most fruitful results rests wholly on the wisdom with which the society shall apply itself to the new tasks. So, also, from another point of view it is the concern of the membership and of the officers of the society that it shall not lose individuality and that the vigor of its internal life shall be fully maintained and even be strengthened.

A Municipal Departure

A NOTEWORTHY step was taken by New York City last week in retaining a firm of consulting engineers to design a sewage-disposal plant to treat the sewage from about one-fifth of the city's population by the activated-sludge process. After twenty-five years' study under first state then city direction, it decided to move away from its historic practice of disposal by dilution, which so far has been modified only in small measure by screening in half a dozen plants built during the last ten or fifteen years.

The Wards Island plant, taking care of the worst pollution (the Harlem River and upper East River), is to be followed in time by other large plants to handle sewage now discharging along the south shore of Long Island. Thus the present step is a beginning on an active general program of high-degree sewage treatment. This is an event which in itself marks an epoch, and does so the more significantly because the largest city in the country is now following Baltimore, Cleveland, Philadelphia, Los Angeles and Chicago in starting on the execution of a comprehensive program of sewage treatment.

In another and quite different sense, also, the New York undertaking is noteworthy. It is the first occasion when New York City has placed a large construction enterprise in the hands of private consulting engineers. Heretofore its invariable practice has been to deal with work of even the largest magnitude and most complex character by its own engineering staff. The procedure adopted in the present case has the significant advantage of permitting

very rapid progress to be made, by eliminating the delay entailed in building up a competent city staff. Moreover, it gave a ready means for entrusting different elements of the work to specially qualified engineers and engineering and architectural firms, who, under the city's consulting engineers, are to design barges, buildings and other parts of the enterprise which call for specialized ability. The precedent established by the present engineering contract may not presage any rapid extension of consulting service in the work of large cities, but it does suggest the question whether staff engineering service may not have been overdone in recent times—both in corporation and in public work—to such a degree that practice may shift back to more extensive utilization of specialized consultants.

Equipment Consciousness

ANYONE who has not noticed that modern construction is relying more and more on machine operations would do well to take note of the constant activity on the part of the manufacturers of construction equipment to make their machines more efficient in order to meet the ever-increasing demands of the construction engineer. Most often their improvements take the form of refinements in details, but sometimes a new machine makes its appearance.

A notable example of an improvement in detail was contained in a recent announcement that a well-known line of rock crushers is to be equipped with automatic splash-feed lubrication. What a shock to be so suddenly reminded that a rock crusher's lubrication system no longer consists of two or three grease cups which are filled with hard oil at the factory but soon become covered with rock dust and then remain forgotten forever! Yet similar refinements are being announced almost weekly. And every type of construction equipment has profited by them. Crawler traction units have almost within the year been universally accepted for use on trailer wagons. Water-measuring tanks, accurate to the ounce, adorn nearly every concrete mixer. Roller bearings contribute to the life and efficiency of more and more wearing surfaces; on one machine a total of 62 such bearings is being used for the various shafts. Ball bearings, too, have enjoyed an increase in application almost equal to that of the roller type; in one instance they have been adapted to use in the sheave of a clamshell bucket. Cut gears running in oil, and alloy steel, meet the exacting modern conditions of speed and long hours of operation. Recent developments that would have been unbelievable several years ago include a four-wheel drive unit for a tractor grader, hydraulic control for a gasoline power shovel and motorized power for a large crosscut saw. The development of a new alloy promises drilling and cutting performances that were considered impossible yesterday. An accelerator-controlled gasoline engine for power-shovel operation is announced as an answer to the demand that daily yardage be increased 15 to 20 per cent. And systems of pressure lubrication in which the lubricant is forced from a central point through tubes to every bearing on the machine have been used and will probably be a commonplace of tomorrow.

Occasionally a new development affects more of a machine than its details. For instance, the pull-shovel or back-digger is available in as many designs as there are manufacturers; eighteen months ago it was a very special type of power-shovel bucket. Recently a finishing machine was adapted to use on asphalt pavement construction. Truck bodies are available that dump to both sides as well as to the rear, thus surpassing in versatility the original side dump of the railroad car. Cranes mounted on motor trucks work on several jobs miles apart on the same day. A centrifugal pump has been successfully used which weighs less than 100 lb. and can almost be considered part of a workman's tool kit.

To the engineer or contractor who has become equipment conscious much of this is common knowledge. To his less modern brother whose mind has yet to become mechanized most of it is news. Modern construction is becoming more and more a series of machine operations. The careful observer will soon come to appreciate this and may perhaps to his surprise find that it is these improvements in construction machinery that are making the wheels of construction revolve faster.

An Expanding Definition

THAT Tredgold's century-old definition of engineering is a thousand-fold broader in its scope of application than he dreamed of is constantly being illustrated anew. One of the latest illustrations comes from Illinois. Although not new unless in adaptation to local conditions and although it shows the engineer trespassing upon what either the entomologist or the ichthyologist might claim as his province, the case in hand nevertheless exhibits utilization of the forces of nature in the service of man. It also affords an example of that temporizing for the sake of immediate results which the best of engineers often find to be necessary.

The main facts in the case are: During the last session of the Illinois Legislature provision was made for the formation of mosquito-abatement districts. Several such districts have now got under way with sanitary engineers in charge. Due to the almost universal pollution of all streams in the Chicago region, the mosquito has been freed from its fish enemies. Depletion of the oxygen content below 2½ parts per million endangers fish life, but mosquitoes still flourish—in fact, certain domestic types thrive best then. Pending the time when the municipalities give sewage engineers a chance to clean up the streams by providing sewage-works, the mosquito-abatement engineers are acclimatizing the top minnow (*Gambusca affinis*) to northern waters by making what few clean ponds there are, such as those on golf courses, into fish hatcheries. Eight club ponds in the Des Plaines Valley district have been stocked with fish from southern Illinois, where the fish is normally found, with the idea that hardy strains will be produced in the course of a few years with which larger bodies of water may be stocked.

Thus the mosquito-abatement engineers are working up to a low-cost method of combating the mosquito pest, meanwhile utilizing oil-abatement methods and presumably looking forward to drainage, at least for some sections, as the most permanent and satisfactory method of keeping down mosquitoes where its cost in money and time is not prohibitive.

Besides illustrating the breadth of Tredgold's definition of engineering, the Illinois case also illustrates the growing scope of the work of the engineer. It would be hard to mention any field of human activity where the engineer is not applying the forces of nature for the benefit of man.

Foundation Construction for the Detroit River Suspension Bridge

Subsurface Conditions—Plant Layout—Sinking and Sealing Methods and Caisson Control —Chicago Wells for Approach Piers—Concrete Control and Winter Concreting

By Edward A. Proctor
Engineering Staff, McClintic-Marshall Company, Detroit, Mich.

Building the Cable Anchorages, tower piers and approach span footings of the 1,850-ft. suspension bridge across the Detroit River required a variety of foundation construction operations. Open caisson dredging, excavation in compressed air and deep curbed well construction were all necessary. Also the work had to be done in winter at top speed to meet a demanded construction schedule. One pier was in the river on a steep shelving bank. All main foundations went far below water level and a deep, thick stratum of quicksand complicated the water difficulties. Then the structures, particularly the anchorages, were very massive and required large-volume production of concrete. The plant and methods for meeting these conditions are described in this article. The design of the bridge was described and illustrated in *Engineering News-Record*, Sept. 27, 1928, p. 460. —Editor.

THE principal foundations of the Detroit River bridge, between Detroit, Mich., and Sandwich, Ont., consist of the piers for the main towers, the cable anchorages and the footings supporting the truss spans from the towers to the anchorages. The general contract for the construction of the bridge, comprising an 1,850-ft. suspension span with wire cables and a total of 5,600 ft. of approach steelwork, was awarded July 19, 1927. Early completion was the essence of the contract and it was quickly evident that the progress of the entire work would hinge on the speed with which the main piers and anchorages could be built. No time was lost, therefore, in issuing plans for these units, and Sept. 20, 1927, saw excavation on the United States anchorage begun, one month and one day after the general bridge contract was awarded. The work was completed to a point where steel erection could begin early in the spring of 1928.

Subsurface Conditions—In and about Detroit the subsurface soils consist almost uniformly of successive layers of yellow clay, blue clay, quicksand and hardpan of varying thicknesses. The core borings taken at the site of the bridge showed the yellow surface clay to be about 15 ft. in depth overlying blue clay varying from 75 to 77 ft. in depth. This underlayer, stiff and gummy, is extremely difficult to handle and was the source of not a little trouble and delay. Underlying this blue clay is the layer of quicksand varying from 21 to 62 ft. in depth; it is very fine and holds a high percentage of water. Covering the bedrock is the hardpan, averaging about 10 ft. thick. This stratum is extremely hard and is not bedded, but rather is of homogeneous texture re-

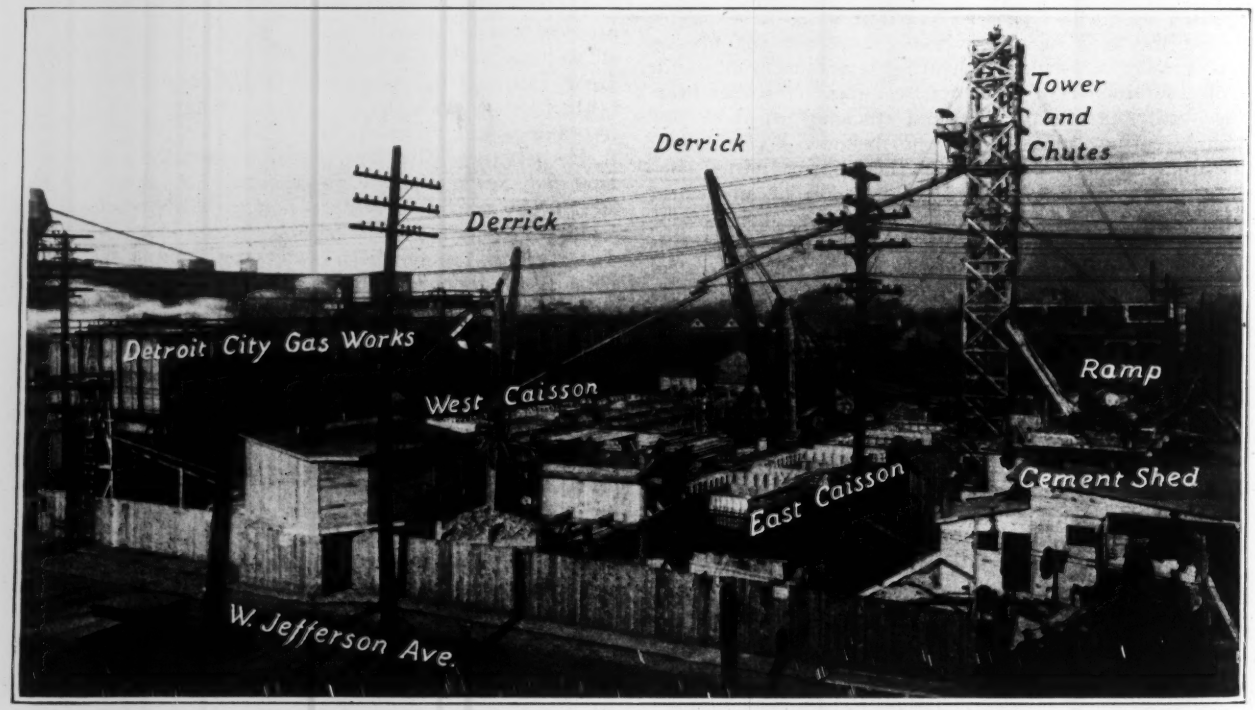


FIG. 1—UNITED STATES ANCHORAGE UNDER CONSTRUCTION
Note method of forming sections of caisson; plant layout conforming to Fig. 2, truck ramp, hoist tower and method of chuting.

semibling concrete with its fine and coarse constituents. So hard was this material that jackhammers had to be used to break it up. For a depth of some 8 ft. above rock and embedded in the hardpan are large boulders, some nearly 15 ft. in diameter, graded with stones of smaller size.

The hardpan with its well-graded aggregate of boulders forms a foundation upon which almost any structure but a bridge of the type of the one under construction could safely be bedded. Due, however, to the tremendous loads on the main piers from the towers, each shaft carrying a design load of 10,000 tons, and the combined tendency of the anchorage caissons to overturn and slide from the pull of the cable, it was thought inadvisable to consider any medium of final reaction other than bedrock. The rock surface is uniformly flat, there being only 6.5 ft. maximum variance in elevation from the United States anchorage to the Canadian anchorage, the extreme points some 3,600 ft. apart, at which rock was

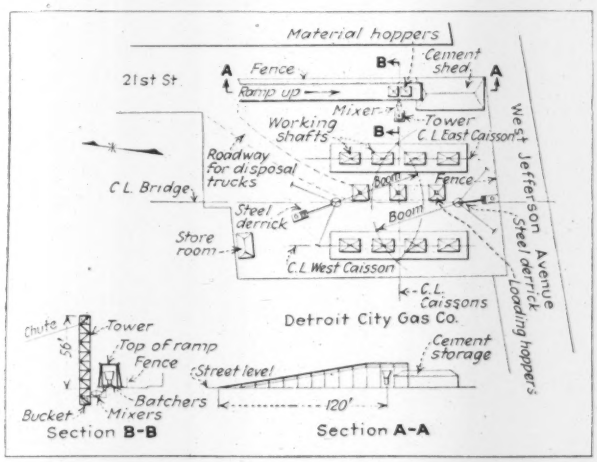


FIG. 2—DIAGRAM PLANT LAYOUT AT UNITED STATES ANCHORAGE

uncovered. The bedding planes are horizontal and the rock is noticeably free from local fissures, seams or cracks. The rock is geologically termed Dundee limestone. When the core borings were made, drills were sent into the rock to a depth of 20 ft. at the sites of the main piers and 70 ft. at the anchorage sites. No signs of imperfections were discovered, the bedding planes being exceptionally well bonded, as was evidenced on one occasion when a single undisturbed core 7 ft. long was removed from the barrel.

An underground condition peculiar to the site of the bridge is the existence of sulphur wells under a pressure greater than river level which, once tapped, produce a continuous and in some instances voluminous flow. When sinking the caissons several of these wells were of necessity struck and the use of pumps, or blowpipes when the caissons were under air, was resorted to as a means of carrying away the water.

Plant Layouts—On the United States side of the river the approach to the bridge lies in a low-class residential and semi-industrial section, while the spans from the anchorage to the main pier cross a large engine house, the main line tracks of three railroads and a group of storage tracks. The character of the section on the Canadian side is exactly the opposite. There the streets are quite open, the district being devoted entirely to residences separated by vacant lots and broad lawns.

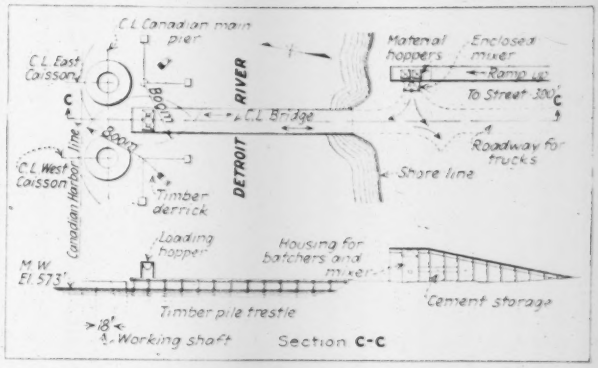


FIG. 3—DIAGRAM PLANT LAYOUT AT CANADIAN TOWER PIERS

This extreme difference, together with the fact that the two anchorages and the United States main pier are located on and surrounded by solid ground while the Canadian main pier is located 250 ft. from the shore in the river, naturally enforced quite different working conditions. While the plant layouts were similar in their general scheme, the working details of each varied enough to warrant mention.

The design of the finished structures lent itself to efficient plant layout and construction methods. Each structure was built up of two identical units, the main piers comprising two 38-ft. diameter cylinders with 18-ft. diameter hollow shafts and the anchorages consisting of two rectangular blocks 100x225 ft. in plan and each having four rectangular working shafts 10.5x16 ft. The volume of concrete in each main pier is about 8,000 cu.yd., while the volumes in the United States and Canadian anchorages are approximately 22,000 cu.yd. and 18,000 cu.yd. respectively. The equipment at both the anchorages and the main piers was therefore selected and laid out in such a manner as to afford continuous operation on the two duplicate units of each foundation.

The cylindrical main piers, each with a single working shaft, allowed, of course, the use of only one derrick on each caisson, but the rectangular anchorage caissons, with their four shafts, were well adapted to the use of two derricks. These derricks, with a single concrete mixing and placing plant, were able to effect alternate

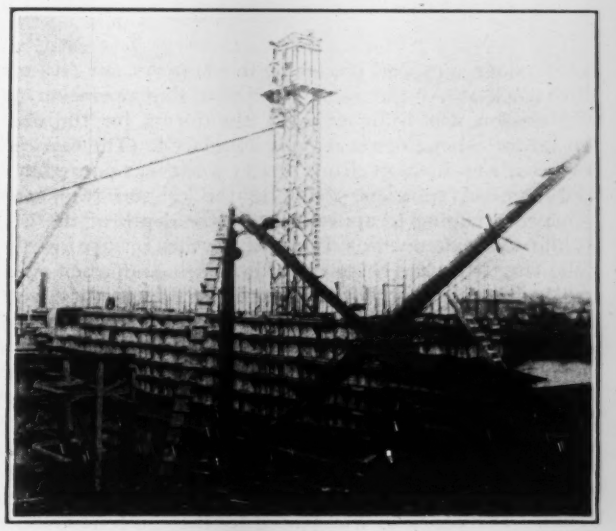


FIG. 4—FORMS FOR CANADIAN ANCHORAGE

and successive building up and sinking periods on each of the two similar caissons of each unit.

All the advantages of duplicate equipment prevailed, therefore, with the actual installation of only a single set-up. The layout of the plant at the United States anchorage is shown in sketch by Fig. 2 and by the view Fig. 1, the Canadian anchorage being treated similarly. Fig. 3 and the views Figs. 4 and 5 show the layout at the Canadian main pier, the river pier, and illustrate the interesting manner in which this more difficult situation was handled.

In considering Fig. 2 it will be noted that both derricks were available for work on either or both caissons. The excavated material from the caissons, raised through the shafts in a clamshell bucket when the caissons were being sunk by open dredging, or in a small cylindrical bucket through the material shafts when the caissons

At the Canadian main pier, Fig. 3 shows the scheme of handling the operation. Two derricks were used, but the necessary departure from the system used on the three other structures was that the concrete was mixed on shore and carried out to the caissons by trucks over a timber and pile trestle. The overhead ramp, hopper and batcher system was also used here to get the aggregates from the truck to the mixer. Trucks carrying bottom-drop buckets were employed to convey the concrete from the mixer to the caissons, the truck backing up to the mixer and taking the batch, then going out the ramp, where the derrick lifted the bucket over the form. The excavated material from these caissons was needed for the bridge terminals, where an earthfill carries the approach grade from street level to the point where the steel viaduct begins. Hence the obvious and easier method of disposal of the excavation into the river

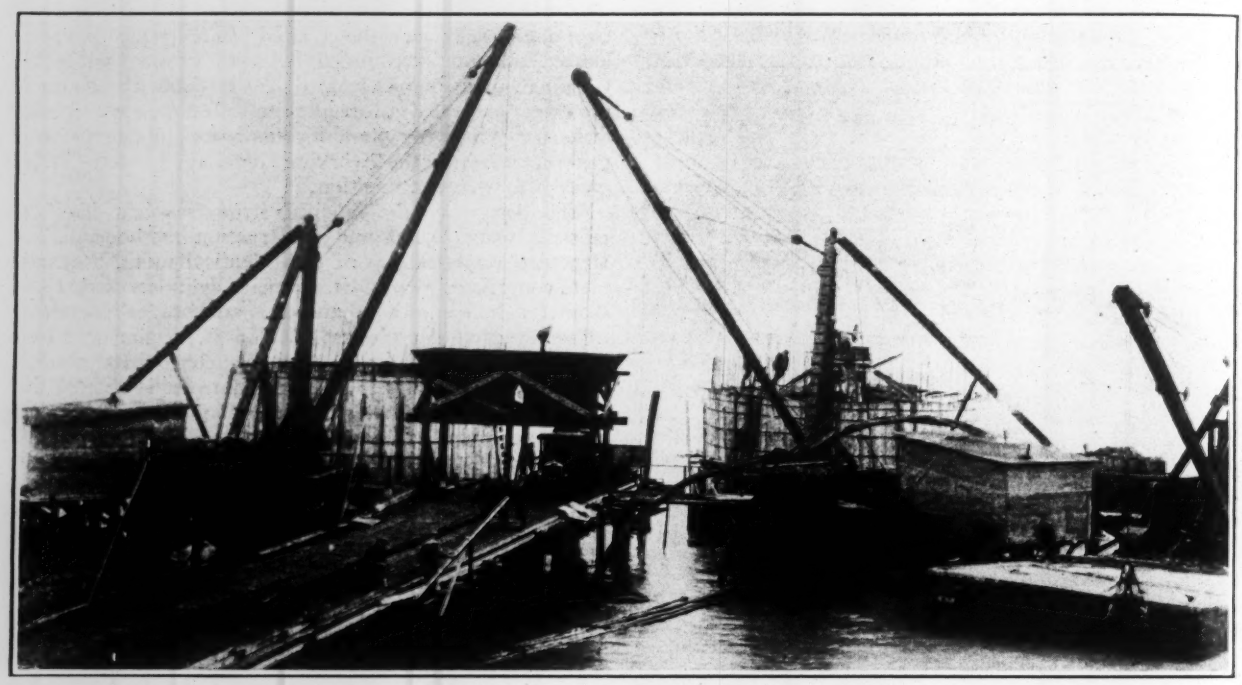


FIG. 5—CANADIAN MAIN PIER UNDER CONSTRUCTION
Derricks are supported on pile clusters and counterweighted with mud boxes. Note trestle and hoppers as indicated in Fig. 3 for loading trucks with excavated spoil.

were under air, was placed in the hoppers for loading into trucks. At the same time that this operation on one caisson was being effected, the forms for the next lift on the other caisson were being placed. The caissons were built up in 17-ft. lifts. After a lift was poured and had attained sufficient strength, the caisson was sunk by open dredging to approximately the depth of the lift. While the caisson was being sunk the forms for the following lift were being made in panels and when sinkage had been accomplished to sufficient depth they were ready to be hoisted into place. It was necessary, of course, to operate one derrick part of the time to place the panels of forms in position for the next lift.

Sand and gravel were delivered to the job by trucks hauling direct from the dealer's yard, the ramp shown in Fig. 2 carrying the trucks over the material hoppers, whence it passed through batchers into the mixer. Cement was stored in a waterproof shed built under the ramp. The concrete was placed by the tower and chute method.

either at the site of the pier or on near-by dumping banks was discarded and the material was placed in hoppers and removed by trucks from the caissons to the terminal site.

Laying the Cutting Edges—The sites of the caissons of the United States anchorage, the United States main pier and the Canadian anchorage were excavated to a maximum workable depth by steam shovel. The bottom was then leveled and the steel cutting edges set to true and level position on planking placed on a cinder bed.

At the Canadian main pier the problem of starting the caisson was more complex due to the pier being located some 250 ft. from shore and at the point where the slack water meets the deeper channel. The depth of water on the shore side of the pier is only 8 ft., while on the river side, only 38 ft. away, it is about 25 ft. This shows the pronounced drop-off of the channel bank. At first some thought was given to constructing the first lift of the caisson on skids on the river bank and floating it to position. This scheme was discarded, how-

ever, in favor of what appeared to be a more economical and expeditious method. This involved building an artificial island by driving a circular wall of steel sheet piling and filling it with sand to above river level. Upon this artificial island the cutting edges were laid, the working chambers were formed and poured and sinking was begun in the usual manner.

Sinking Methods—From the elevation at which the cutting edges were laid until the caissons rested on hardpan, sinkage was effected by dredging in the open through working shafts. The caissons were always kept built up to the maximum workable height above ground to secure the greatest weight possible, every available pound being required to drop the caissons through the blue clay. No superimposed loading was used, however, until the final lifts of the anchorage caissons had been poured, when timber cofferdams were built on top of the caissons

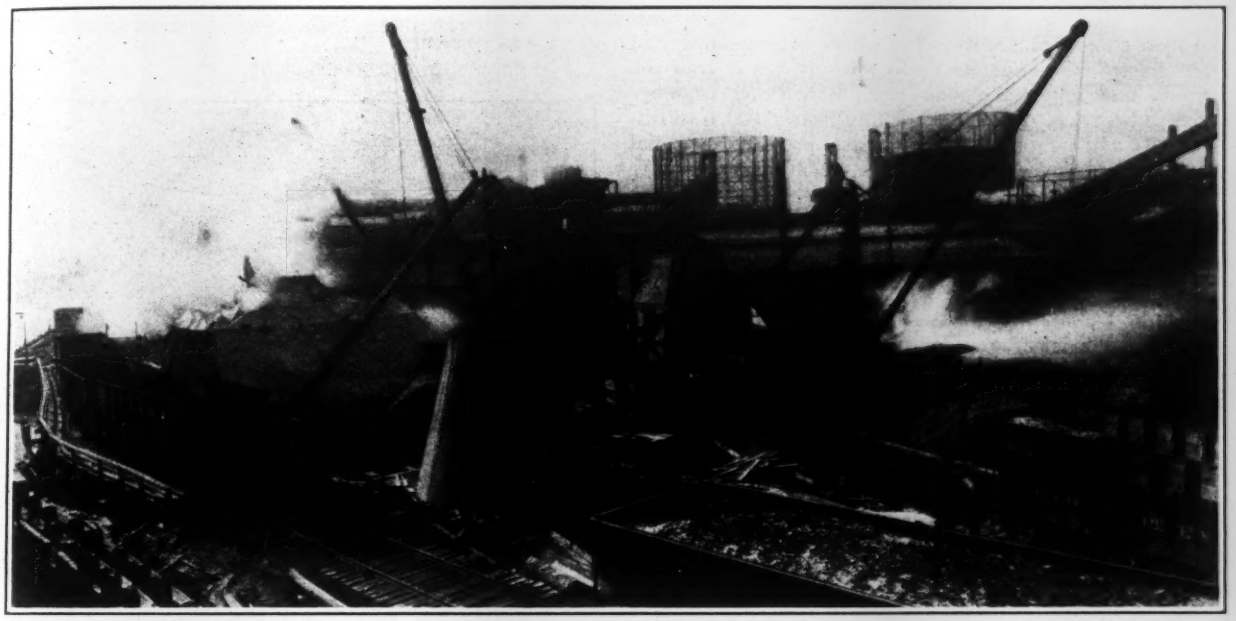


FIG. 6—UNITED STATES PIER UNDER CONSTRUCTION IN MIDWINTER
On the left is the east caisson completely inclosed with tarpaulins and on the right are the stock piles. Note steam vapor arising from heating pipes.

and excavated material was deposited therein. Upon reaching the quicksand the dredging became easier, but the tendency of the sand from the surrounding territory to be drawn under the caisson as the sand in the shaft was removed produced evidences of settlement under near-by structures. To overcome this condition the walls of the caissons were flooded with water to about river level. This surcharge created the necessary pressure on the sand in the well to counteract its pressure head and the danger of run-ins was eliminated.

One detail of the construction of the working chambers was thought to have caused considerable resistance to sinking and could have been eliminated if the condition had been foreseen. The roof of the working chamber was built up in steps to bring the construction joints, upon sealing, as nearly as possible at right angles to the stress line. This produced, however, a bearing surface on the bottom of the caisson walls which created additional resistance to be overcome by the weight of the caisson when sinking. This condition could have been overcome by timbering the roofs of the working chambers to form a sloping surface, thereby eliminating all opportunity for the caisson to secure full bearing on the soil.

With the cutting edges resting on the hardpan, further sinking could not be obtained by open dredging. The caissons were consequently fitted up for air and the excavation continued in the working chambers by hand. Sinkage was then secured by blowing the caissons—that is, reducing the air pressure and thereby increasing the static weight of the caissons, causing natural settlement. At times the air was allowed to remain off as long as 30 minutes and it was particularly noted on these occasions that with the cutting edge firmly embedded in the hardpan, very little sand and water found their way into the working chamber through this natural seal.

For the main piers, the caissons were sunk until the cutting edges were practically resting on the rock table. With the anchorage caissons, however, the resistance to settlement of the caissons was so great that it was found advisable and expedient to hang up the caissons in the hardpan, carrying the excavation as usual to bedrock and concreting the intervening depth in the process of sealing.

Control of Caissons During Sinking—The United States main pier cylinders, which were commenced in firm and stable soil, went down speedily and truly plumb.

The corresponding Canadian cylinders, being supported on the more or less unstable under-water clay bank, showed a tendency to drift into the stream and vigorous measures were taken to restore them sufficiently close to plan position. These consisted principally of excavating with a clamshell the shoreward bank which was producing the surcharge and temporarily depositing this material on the river side to offer resistance. Also, after pneumatic excavation was commenced, inclined timber struts and rails were wedged up under one side of the cutting edge, so that as the caisson was blown it would receive a component in the direction of the desired restoration of position.

The anchorage caissons, being relatively narrow and

light for their great height, showed variable tendencies to travel during sinking. The west caisson of each pair, the sinking of which lagged behind the east member, showed much the greater tendency to drift and lean.

Leaning of the west caisson tops toward the east was prevented by strutting between the two caissons of the pair with struts composed of four 12x12-in. timbers bolted together, abutting against the walls between the dredging walls. On the Canadian side these struts were supplemented by hydraulic jacks and by temporary excavation on the outer side of the west caisson, and as this jacking force was not introduced until the east caisson had been carried into the hardpan, all of the resulting displacement was imparted to the west caisson as desired.

Sealing—After the caissons were bedded, the rock surface and the roof of the working chamber were thoroughly cleaned preparatory to sealing. Sealing, once started, was a continuous process until the concrete was up in the shaft to the top of the working chamber roof. No men entered the working chamber after sealing had been started, the concrete finding its own way into the corners and under the steps of the working chamber roof. The batch of concrete, falling nearly 100 ft. down the shaft and plunging into the mass, produced a radial wave of disturbance in the concrete which insured proper puddling of the surfaces forming the joints with the existing caisson. The compressed air was kept in the chamber 48 hours after the operation of sealing was complete and at the same pressure that had been previously maintained.

Winter Concreting—The heavy foundation construction program, starting as it did in September and continuing until late spring, could not be classed as other than a winter operation. The specification governing the depositing of concrete under these conditions stated that "in freezing weather suitable means shall be provided for maintaining the concrete at a temperature of at least 50 deg. F. for not less than 72 hours after placing."

The means used to conform to this stipulation were well planned and rigidly adhered to during the cold season. The material stock piles were kept from freezing by pipe lines carrying live steam (Fig. 6). The efficiency of this installation was evidenced by the fact that at no time did the material become frozen. The material hoppers were kept warm by steam coils around the outside surfaces, while live steam was shot directly into the water tanks. The concrete usually left the mixer at about 75 deg. F. Perforated piping carrying live steam was placed inside the forms and the forms were totally inclosed by tarpaulins. No difficulty was experienced in keeping the concrete well above the 50 deg. F. minimum with these provisions for heating. On one particularly wintry night, with the mercury showing around 5 deg. F., a pour of 450 cu.yd. and of fifteen hours' duration was made, with the temperature readings in the deposited concrete, taken at half-hour intervals, showing a range between 52 and 68 deg. F. This specific example of maintaining a temperature inside of the forms practically 50 deg. above outside temperature illustrates the practicability of pouring concrete in exceedingly low temperatures when circumstances do not warrant the loss of a single day in the progress of the work.

Chicago Wells—The footings for three of the supporting bents of the United States truss spans carrying the roadway from the main tower to the anchorage are located within or directly adjacent to a large engine house. Soil bearing could not be secured and it would have been an exceedingly dangerous and probably damaging operation to the engine house to attempt to drive timber piling so near to the existing structure if it had even been physically possible to do so. It was decided, therefore, to sink Chicago wells (Fig. 7) to sand and on comparison between belling out under compressed air at the bottom and supporting the pier by bearing on the sand, or driving from elevation of top of sand steel pipe piles and filling them with concrete, the latter scheme was selected.

The wells, 8¼ ft. in diameter, were sunk by hand, using 1¾-in. lagging and 6-in. channel rings. No trouble was encountered in the stiff blue clay when lagging in 6-ft. sections. The design called for the excavation to stop at a point 10 ft. above the sand bed as determined by the test borings. This was considered to leave enough of a mat to withstand the pressure of the water in the sand. On three of the six wells, however, the water broke through into the shaft; by quickly backfilling with about 6 ft. of gravel, running in of the sand itself was prevented.

The driving of the pipes, eight in each well and 18 in. outside diameter, was accomplished without incident. The maximum design load on any single pile is 100 tons, the pipes being driven to refusal. Two wooden templets spaced 10 ft. vertically and built into the shaft, served to guide the pipes true and vertical while they were being driven.

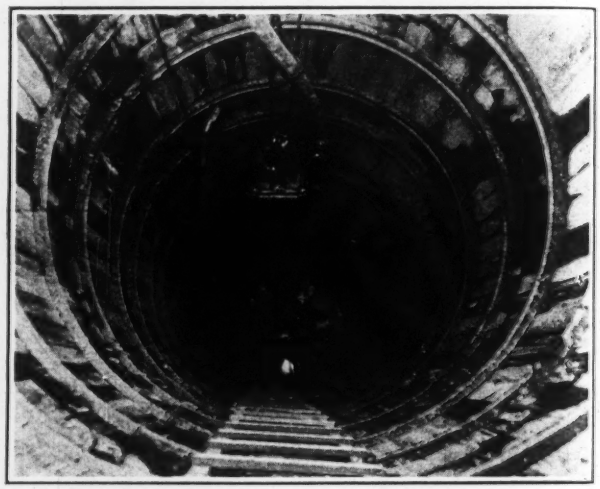


FIG. 7—CURBED WELL FOR APPROACH SPAN FOUNDATIONS
Note well curbing, templet for spotting piles and piledriver at work.

With the pipes driven to refusal, they were blown clean and filled with 2,000-lb. concrete. After concreting, steel plate bearing caps were placed on top of each pile and the open shafts filled with concrete.

Concrete Testing and Inspection—The staff for the testing of the materials to be used in concrete and for the inspection of mixing and placing was organized as a unit of the field engineering force under the engineer of construction. The responsibility for testing the materials and the design of mixes was vested in the head of this staff. The force numbered enough men for the assignment of two inspectors to each point of pouring, one being stationed at the mixer and the other in the forms. The inspector at the mixer was charged with checking the quality of the aggregates, the water and cement content and the time of mix, while his co-worker in the forms was responsible for the proper bonding of

the reinforcing steel, the rodding of exposed surfaces and the prevention of segregation.

With the letting of the foundation sub-contracts, the sub-contractor was required to submit his probable sources of aggregates to the engineer of construction. The materials were then inspected at the pits or in the dealer's yard and preliminary tests made according to the specifications. With the materials accepted for use, experimental tests were then made previous to the start of concreting to ascertain the characteristics of the materials for designing the proper mix to give the required strength. The aggregates were proportioned by the water-ratio method to give the specified minimum strengths, there being two classes of concrete used, 1,600 lb. and 2,000 lb. The design of the mix was first made by the trial method and then was checked by calculation to give a workable concrete having maximum density and weight and having a safe margin over the minimum strength specified. To obtain the minimum strengths of 1,600 lb. and 2,000 lb., the mixes were designed for 2,200 lb. and 2,500 lb., respectively. With the design so close to the minimum, there was a decided saving in cement to the sub-contractor, but necessarily stringent adherence to the specifications and rigid inspection.

The number of test cylinders taken was a function of the yardage of concrete poured, one cylinder being taken for about every 100 cu.yd. of concrete, but never less than three cylinders from a pour. The average 28-day breaking strength of 285 test cylinders of 2,000-lb. concrete was 2,790 lb. per sq.in., and the corresponding break of 110 test cylinders of 1,600-lb. concrete was 2,396 lb. per sq.in. Nine per cent of the 2,000-lb. test cylinders fell below the minimum, while the corresponding figure for the cylinders of the 1,600-lb. concrete was only 5 per cent.

Much attention was given throughout the job to the workability of the concrete. The different methods of placing and the varying size and shape of forms and the amount of embedded reinforcing necessitated the use of a wide range of slumps. It was specified that the maximum slump should be from 3 in. for mass volumes to 4½-6 in. for thin reinforced sections. At the anchorages, however, where the concrete was chuted from top of tower to forms, it was necessary at times to increase the slump above these limits to secure rapid flow, the slump range being between 4 and 7½ in. depending upon the angle of the chutes. The sub-contractor compensated for this increased water content by the addition of cement when needed. On the main piers, where buckets were used and where placing was under almost ideal conditions, much lower slumps were run, the range being from 1 to 4 in. The regulation of slumps for the varying conditions was satisfactory throughout and can be attributed to the use of inundators and batchers which eliminated variance in volumes of sand and stone. Graduated adjustable water tanks which assured a uniform volume of water for every batch were used and found to be of great value. The entire efficiency of this type of proportioning and mixing equipment lies, however, in its operation by intelligent workmen.

The engineer and contractor of the entire bridge project is the McClintic-Marshall Company, of Pittsburgh, Pa. The pneumatic caisson work, consisting of the main piers and the cable anchorages, was sublet to the Foundation Company, while the Chicago wells and pipe piles of the piers under the United States truss spans were constructed by H. H. Esselstyn, Inc., of Detroit.

New Preservative Adds to Structural Possibilities of Wood

Treatment With Zinc Meta-Arsenite Does Not Affect Strength of Wood—Surfaces May Be Painted

WIDENING of the field in which treated lumber may be used to advantage is promised by a new wood preservative developed by L. P. Curtin, of the Western Union Telegraph Company, in an effort to find a wood preservative for the poles of the telegraph company which would be less expensive than creosote and would not increase their electrical conductivity. This preservative, known as zinc meta-arsenite, not only does not increase the conductivity of the wood but does not reduce its strength as a structural material, as does zinc chloride and certain other chemicals used for wood preservation, and in addition does not affect its capacity to take and hold paint, nor does it have a corrosive effect upon metal with which it comes in contact.

The discovery of zinc meta-arsenite as a wood preservative came about through attempts on the part of the Western Union Telegraph Company to develop a preservative which would be more suitable to its purposes than the preservatives heretofore used and which would not be as limited as is the present supply of creosote now so widely used for wood preservation.

The wood-preserving industry has always had as one of its basic principles the theory that any salt to be effective as a wood preservative must be slightly soluble in water. Otherwise, it was argued, how would its toxic properties function unless it was slightly soluble in the juices of wood-destroying fungi? When Dr. Curtin, chemist of the telegraph company, began his studies he discovered that the theory would not hold—that due to the acidic content of the juices of wood-destroying fungi it was not necessary that the poisons in wood should be soluble in water. To the contrary, he showed that it was possible to have what is known as an insoluble salt present in wood become soluble in the presence of these wood-destroying fungi and as a result kill the fungi. These conclusions have since been verified by an independent European investigator. Having proved this fact, Dr. Curtin began to investigate the field of possible chemicals that were available in large quantities, of high toxicity, of permanence, low electrical conductivity and non-corrosive, as well as of low cost. His investigations led him to the conclusion that zinc meta-arsenite was the chemical most suited to his purposes. Its toxicity is much higher than any other commercial preservative and its availability is not limited.

The application of zinc meta-arsenite to wood does not require the use of any new equipment. Where absolutely clean lumber is not required, any plant equipped for treating by either full-cell or the Reuping process, using initial air pressure and final vacuum, can use the preservative without making material changes in the plant equipment. Where lumber is required free from contamination by creosote and oils used in existing creosoting plants, a separate plant would be required.

This new preservative has been known only for something over three years, but accelerated tests indicate that it will live up to expectations. The Western Union Telegraph Company is sufficiently satisfied on this point as to have standardized upon its use for yellow pine poles and crossarms.

From the standpoint of cleanliness, this new preservative offers something which has been long wished for. Wood treated with it is just as clean as before treatment when the process is carried out in a clean plant. The color of the wood is not changed and paint or lacquers can be applied after the wood has attained its proper moisture content. This makes it available for many classes of structural work, especially for railroad car bodies, where it has not been possible heretofore to get satisfactory results on account of the effect of creosote oil upon paint.

The solubility of zinc meta-arsenite in water is very low, about 25 parts per million parts of water. Consequently it may be used to advantage for the treatment of railroad track ties which are exposed to the weather and from which salts which are soluble in water eventually leach away.

Tests upon long leaf and short leaf yellow pine and red oak treated with zinc meta-arsenite indicate that the preservative salt has no detrimental effect upon the tensile or compressive strength of the wood. In a series of tests carried on by the Western Union Telegraph Company upon these three classes of wood, the results ranged above and below the average in such a way as to indicate that the salts had no effect upon the strength of the timber.

This preservative is now being produced on a commercial basis and is being marketed by the Curtin-Howe Corporation, of New York.

Flying Débris Responsible for Window Failures in Florida

WHAT appeared at the time to be a failure of large steel windowsash through wind pressure alone was reported by R. S. Tilden in a survey of storm damage in Florida, published in our issue of Oct. 4, p. 515. Further investigation, however, indicates that such was not the case. A report from F. Avery, building and equipment engineer, Southern Bell Telephone & Telegraph Company, states that one of that company's employees stationed in its garage warehouse in West Palm Beach (the building in question) reported that one of the large sash, approximately 10 ft. square, which was bowed in and appeared to have been bent in by wind pressure, actually was struck on one of the mullions by a plank blown off a warehouse some three blocks north of the building. Other windows suffered from similar flying objects. Mr. Avery also reports that shutters of the rolling steel type were made useless by being struck by flying objects, such as timber and tiles. Similar windows higher up in buildings equally exposed to wind pressure but above the path of the heavier flying objects were undamaged.

GARAGE AND WAREHOUSE OF SOUTHERN BELL TELEPHONE COMPANY
Window which was bowed in at extreme right.

CLOSE-UP OF WAREHOUSE WINDOW
Marks on the mullions and the character of the glass fractured indicate clearly that this and other windows were struck by heavy débris carried before the wind.

Time Extensions on Contracts

Granting time extensions on certain forms of government contracts cannot be done by the engineering or administrative officer in charge of the contract, under a decision recently made by the Comptroller General (noted in *New Reclamation Era* of November, 1928). The case was one in which a contractor for certain equipment asked for a three months' time extension after the date fixed for the completion of contract, although the contract not only provided a time of completion but fixed liquidated damages for all delays not due to certain specified causes. It is held that "the administrative authority is limited to either canceling the contract for default in delivery or permitting the contractor to continue until performance has been completed and reporting the facts of the delay to this office for consideration as to whether liquidated damages should or should not be charged under the contract."

Mechanical Spreading of Rock Asphalt

In the Nov. 15 issue of *Engineering News-Record*, p. 727, appeared an article entitled "Rotating Rake on Finishing Machine Spreads Rock Asphalt." By a typographical error the author is given as John L. Hubbard. The article should have been credited to John L. Humbard, of the John L. Humbard Construction Company, of Knoxville, Tenn.

Fertilizing Value of Baltimore Sewage Sludge

Field Experiments Covering Five Years Indicate That Sewage Sludge Gives Best Results When Used to Fertilize White Potatoes, Cabbage and Corn

By C. E. Keefer and G. K. Armeling

Engineer of Sewage Disposal and Superintendent, Baltimore Sewage-Works, Respectively, Bureau of Sewers, Baltimore, Md.

Back to the Land with the nitrogenous and other crop foods in city sewage is the ideal toward which many sewage-works engineers and managers are working today. To stimulate this means of disposal, as already practiced quite extensively at Baltimore, those in charge of the works there, in conjunction with the agricultural department of the University of Maryland, conducted for several years the working-scale experiments described in the following article. —Editor.

FEW experiments of an extensive nature have been conducted in the field to determine the fertilizing value of sewage sludge. That there is need for such work is evidenced by the large quantities of this material used by the farming industry in this country and abroad. In order to answer a few of the many questions involved, experiments lasting five years were conducted at the Baltimore sewage-works. Six different crops were planted on a tract of land containing nine acres. This area had been treated with sludge and also with various kinds of fertilizing materials. It was thus possible to observe which crops produced the largest yields. Such information should be of value to those agriculturists and engineers who are interested in the use of sewage sludge.

The final disposal of this material is one of the vexing problems that usually confronts the operators of most sewage-works. If the plant is situated in a rural or agricultural district, a portion or all of the sludge will frequently be taken by farmers. The remainder is generally left at the sewage plant in one form or another. Such has been the experience at Baltimore, where the sludge is air dried on sand beds after its removal from primary and final settling tanks and digestion in separate sludge tanks. Less than 2 per cent of all the sludge comes from the final settling tanks. When the material is removed from the sludge beds, it contains from 65 to 70 per cent moisture and from 50 to 65 per cent volatile matter. The following is a typical analysis of the air-dried sludge on the dry basis:

	Per Cent
Nitrogen as NH_3	2.2
Total phosphoric acid as P_2O_5	0.5
Potash as K_2O	0.2
Fats	9.8

One disadvantage of drying sludge on sand beds is that each load of the dewatered material contains approximately 5 or 6 per cent sand. The nitrogen as ammonia in the sludge would naturally be higher if the sand could be excluded. If some satisfactory means were available for dewatering sludge, possibly by mechanical filters or centrifuges, a more desirable fertilizer would result.

Past Experience With Sludge Disposal—For the first few years after 1912, when the Baltimore sewage-works was put in operation, the disposal of the sludge was a question of little importance. The sewage flow was small, and there was sufficient capacity in the digestion tanks to retain the sludge for many months. Some of the material in both the wet and the dry forms was sold to neighboring farmers. The remainder, a small amount, was used for filling low-lying ground at the plant. By 1915 it became apparent that some definite means should be adopted to dispose of the sludge. A contract was therefore made with a reduction company, which erected a plant at the sewage-works. From 1916 to the early part of 1923 it heat dried a portion of the sludge and sold it as a filler for fertilizer (*Engineering News-Record*, Feb. 11, 1926, p. 238). Since 1923 the principal method of disposal has been to give it to neighboring farmers. They haul it to their fields in trucks and wagons, which are loaded by means of a 5-ton locomotive crane. Efforts are continually being made to stimulate the farmer's interest in the use of this material.

For the five-year period from 1923 to 1927, 100,000 cu.yd. of sludge was removed from the drying beds, of which amount 45,000 cu.yd. was given away for fertilizing purposes. During the past three or four years considerable quantities of sludge have been used on the lawns at the sewage-works. About 10 tons (9 cu.yd. per acre) is distributed over the ground in the early winter. In the spring that which remains is disintegrated by hauling a lapboard drag over the lawns. Applied in this quantity, the total output of air-dried sludge, amounting to about 20,000 cu.yd. annually, would fertilize 2,200 acres. This method of treating lawns has been so successful that a considerable quantity of the sludge is used in the city parks and at the water-works filtration plant. Since Jan. 1, 1928, more than 8,000 cu.yd. has been hauled a distance of 8 miles at a total cost of 95c. a cubic yard to two city parks, where it has been spread over denuded ground to take the place of topsoil.

Year by year the disposal of sludge at the Baltimore sewage-works is becoming more of a problem. This condition is due partly to the larger quantities handled and partly to the fact that territory adjacent to the works has changed from a farming to a semi-urban district. In order to meet these changing conditions and to stimulate the interest of farmers in the use of sewage sludge, experiments were conducted along practical lines in conjunction with the agricultural department of the University of Maryland. Some of the questions to which answers were sought were: What crops thrive best when sludge is used? To what extent does it contribute plant food to the soil? Does the sludge produce any detrimental effects? Does it continue to fertilize the ground during the second year after its application? The experimental work was started in May, 1923, and was concluded in 1927. An area 435.6x1,000 ft., with sufficient slope to permit good drainage, was divided into six equal sections of 1½ acres each. Each section was in turn divided into a number of equal plots on which different crops were planted.

Method of Fertilizing Soil—The quantities of fertilizing material applied to each of the sections are given in Table I. Before the experiments were begun the soil

TABLE I—FERTILIZING MATERIALS USED ON EXPERIMENTAL FARM

Weights Per Acre

Section No.	1923 and 1924	1925 and 1926	1927
1	10 tons stable manure	10 tons stable manure	No treatment on any section
2	1,000 lb. 5-8-5* commercial fertilizer	1,000 lb. 5-8-5 commercial fertilizer	
3	No treatment		
4	1,000 lb. 2-8-2 commercial fertilizer and 20 tons dried sludge	1,000 lb. 5-8-5 commercial fertilizer and 40 tons dried sludge	
5	20 tons dried sludge	40 tons dried sludge	
6	40 tons liquid sludge	300 lb. 5-8-5 commercial Fertilizer and 40 tons dried sludge	

*Five parts ammonia, eight parts phosphoric acid and five parts potash.

TABLE II—PER CENT N AS NH_3 IN SLUDGE USED DURING 1923 TO 1926

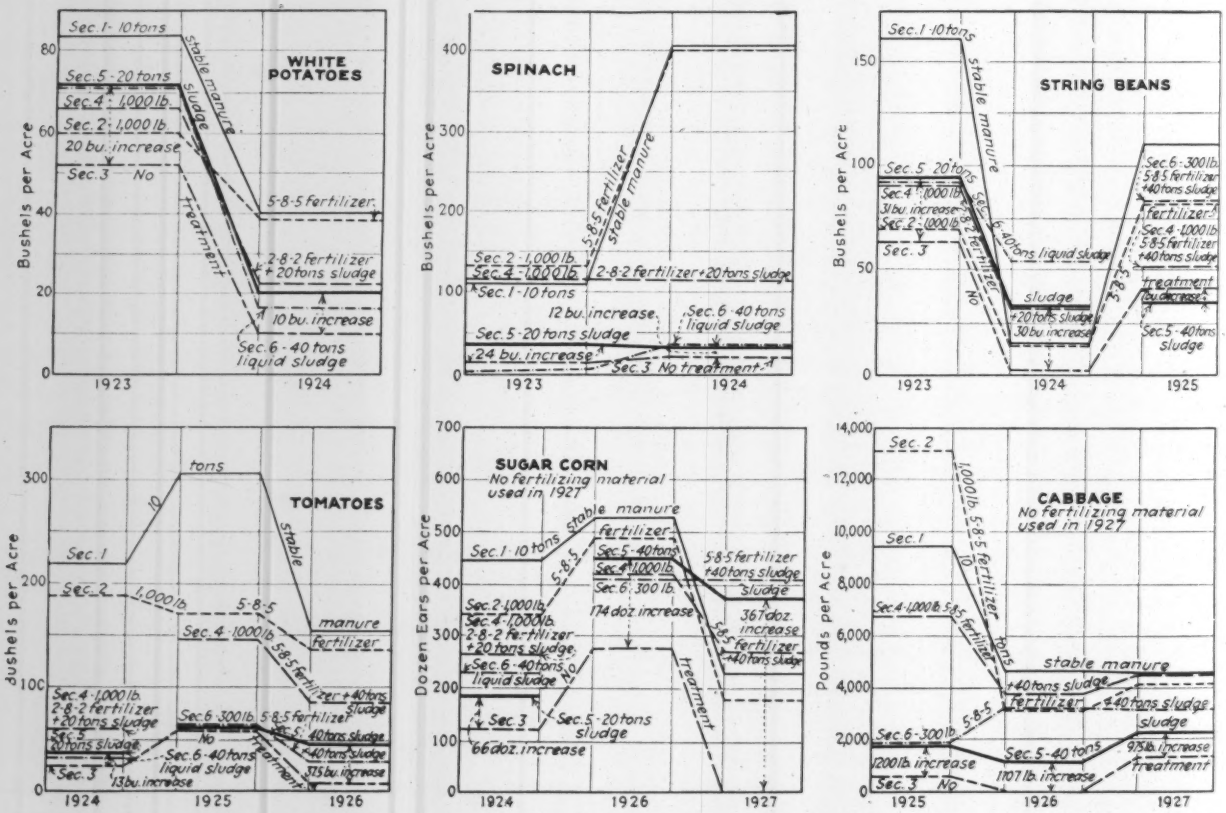
Percentages on Dry Basis

1923	Section 4 No analysis	Section 5 No analysis	Section 6 No analysis
1924	2.56	2.56	3.19*
1925	2.06	2.25	1.84
1926	1.56	2.03	2.33

*Liquid sludge.

was sampled and tested. The characteristics of the ground on the whole were uniform except that a portion of the field was acid. This condition was corrected by applying, where necessary, 2,000 lb. of pulverized limestone per acre. Stable manure, used on section 1, was applied in 1923 in the early part of the summer and usually in March in the following years. All of the commercial fertilizer put on section 2 was distributed over the ground before any plants were sowed. The land was then plowed and disk harrowed. During 1925 and 1926, however, 800 lb. per acre was applied before the crops were planted and 200 lb. after the crops had begun to grow. Some of the latter quantity was put around those plants which showed the least growth. Section 3, to which no fertilizing materials were added, was utilized for control purposes. Commercial fertilizer and air-dried sludge were used on section 4. Only air-dried sludge was applied to section 5. This material was spread over the fields in the winter, when the ground was frozen, and was plowed under in the spring. Liquid sludge, which was put on section 6 in 1923 and 1924, was no longer used in 1925 because of the inadequate facilities for handling it. Instead, air-dried sludge was used together with 300 lb. of commercial fertilizer per acre, 100 lb. of which was applied to the soil after the plants had begun to grow. Analyses of the sludge put on sections 4, 5 and 6 are given in Table II. There was considerable variation in the nitrogen in the sludge. The chief reason for this fluctuation was that varying quantities of sand adhered to the sludge which was removed from the drying beds.

Work Done From 1923-1926—When the experiments were begun in 1923, it was believed that little more than a beginning would be made during the first year but that the findings and experience obtained would be a valuable guide for the work done during subsequent years. The general policy adopted in 1923 and followed thereafter was to plant the same crop on one plot in each section for comparative purposes. Table III shows when the crops were planted and harvested from 1923 to 1927, inclusive, except crimson clover and rye, which were plowed under. The yields of the six crops are represented graphically herewith. White potatoes were



EXPERIMENTAL RESULTS FROM FERTILIZING SIX KINDS OF CROPS WITH SLUDGE FROM BALTIMORE SEWAGE-WORKS

For comparison, experiments were also made with stable manure, commercial fertilizer and a combination of the latter and sludge. All sludge was air dried on open beds except where liquid sludge is specified. All quantities of fertilizing material are given in tons per acre.

planted in 1923 and 1924 on each of the sections. During the former year the potatoes thrived best on section 1, which was treated with horse manure, and next best on sections 5 and 6, where air-dried and wet sludge were used, respectively. A larger crop was obtained from the last-mentioned two sections than from section 2, where 5-8-5 commercial fertilizer was applied. Since section 3, which had no treatment, yielded 52 bu. per acre, it is apparent that the ground contained residual fertilizing constituents when the experiments were begun. The yield of white potatoes on all the sections during 1924 was less than during 1923. A maximum of 40 bu. per acre was obtained from section 1, and a minimum of 10 bu. per acre from section 3, where the soil received no treatment. A possible reason for the poor results during 1924 was the great amount of rain during the summer. Section 5, on which 20 tons per acre of dried sludge was prevented a high yield. The best results were got from all the sections during 1925 in spite of the harmful effects of the hot and dry weather during the middle of the summer. Section 5 showed an average increase in yield over section 3 in 1924 and 1926 of about 25 bu. per acre.

Of all the crops planted the results obtained with corn were the most interesting in that the sludge was of more benefit to this crop than to the others. The highest yields occurred during 1924 and 1926 from sections 1 and 2 and the poorest from section 3. The beneficial effects of sludge are apparent, as section 5 produced 66 doz. ears per acre more than section 3 during 1924 and 174 doz. more during 1926. In the former year 20 tons of air-dried sludge per acre was used and 40 tons during the latter year. The increase in the amount of sludge applied is reflected in the higher yield.

TABLE III—DATE OF PLANTING AND HARVESTING CROPS, BALTIMORE SEWAGE-SLUDGE EQUIPMENT

Crop Planted		1923		1924		1925		1926		1927	
Kind (1)	Quantity Per Acre (2)	Planted (3)	Harvested (4)	Planted (5)	Harvested (6)	Planted (7)	Harvested (8)	Planted (9)	Harvested (10)	Planted (11)	Harvested (12)
Early cabbage	6,000 plants	Nov. 26	See col. 6	.....	June 30 to July 9	Dec. 1	See col. 10	.....	June 26 to July 28	.....	.....
Spinach	25 lb.	Sept. 1	Nov. 14-15	Aug. 8	Sept. 25 to Oct. 2	.....	.....	.....	.....	.....	.....
Crimson clover	16 lb.	Aug. 9	May 14, 1924†	Sept. 16	.....	.....	.....	.....	.....	.....	.....
String beans	48 lb.	Aug. 8	Apr. 23, 1924 Sept. 16 to Oct. 14	April 24 to 30	Aug. 18 to Sept. 4	May 2	July 13 to Aug. 13	.....	.....	.....	.....
White potatoes	15½ lb.	July 12	Oct. 30 to 31	July 12 to 16	Nov. 18	.....	.....	.....	.....	.....	.....
Tomatoes	3,000 plants	.....	.....	June 21 to July 8	Sept. 9 to Oct. 20	May 10	Aug. 25 to Oct. 5	June 10	Sept. 3 to Oct. 15	.....	.....
Sugar corn	4 to 8 qt.*	.....	.....	May 15 to 24	Aug. 18 to Sept. 4	.....	.....	May 18	Aug. 20 to Sept. 22	May 24	Aug. 25 to Oct. 6
Late cabbage	6,000 plants	.....	.....	June 28 to July 8	Sept. 25 to Oct. 24	June 22	Sept. 9 to Oct. 7	.....	.....	April 23 to 28	July 13 to Aug. 15
Rye						Nov. 15	See col. 10		May 5†		

*Rows 4 ft. apart, hills 3½ ft. apart. †Date when crop was plowed under.

used, produced 20 bu. per acre more potatoes than section 3 during 1923, and 10 bu. per acre more during 1924.

Spinach, which was planted in 1923 and 1924, thrived best on sections 1 and 2, whereas the yields from both sections 5 and 6 were low. Section 5 gave 24 bu. per acre more than section 3 during 1923 and 12 bu. more during 1924. This crop benefited but little by either the wet or the dry sludge.

String beans were planted in 1923, 1924 and 1925. On the whole the production from all the sections was best in 1923, somewhat less in 1925 and lowest in 1924. The yield on section 5 in 1923 compared favorably with that from the other sections except in the case of section 1. The production during 1924 was erratic because of climatic conditions. Excessive rains washed out many of the plants after they had started to grow. Furthermore, a mistake was made in sowing the beans in the same plots where crimson clover had been previously planted and plowed under. A quantity of grass and weeds, which usually follow clover, grew up with the beans, and produced detrimental effects. In 1924 a hailstorm injured the beans, but since the damage was the same on all the sections, the quantities of this crop harvested are comparable. During this year the best results were obtained with stable manure and the poorest with air-dried sludge, which yielded 17 per cent less than section 3. Section 5 gave an increase over section 3 of 31 bu. per acre in 1923, an increase of 30 bu. per acre in 1924, and a decrease of 7 bu. per acre in 1925.

Tomatoes were planted in 1924, 1925 and 1926. During the first of these years about two-thirds of the tomato plants rotted because of the heavy rainfall and had to be replaced. Excessive rains occurred again in 1926 and

Cabbage was planted each year from 1924 to 1927, inclusive. The results for 1924 are not given, as the work done during the three other years indicates sufficiently well how this crop reacted to the different fertilizing materials. A small yield resulted in 1926 because of the heavy and continual rains and other adverse weather conditions. Sections 3 and 5 produced less during each year than any of the other sections. Section 5, however, had an average production of 1,094 lb. per acre more than section 3 for the duration of the work.

Work Done in 1927—One point of interest relative to the fertilizing value of sludge is whether this material continues to contribute plant food to the soil during the years following its first application. To answer this question cabbage was planted on one plot and corn on two plots in 1927. The former crop was set out in April (see Table III), but because of the cold weather it had to be supplemented by additional plants. The corn planted in May was so badly damaged by crows and cutworms that more than 50 per cent of it was replanted on June 24.

The quantity of corn harvested is of decided interest. There was a decrease in yield during 1927 of 57, 64 and 100 per cent on sections 1, 2 and 3 respectively as compared with 1926. Section 5, treated with sludge, showed a decrease of 18 per cent, while the production on section 6 during the two years was about the same. Section 5 yielded 367 doz. ears per acre more than section 3. Both sections 5 and 6, which were treated with sludge, gave the best results.

The yield of cabbage on sections 1 and 2 in 1927 was considerably less than in 1925, while the production on sections 5 and 6 was slightly greater during the former

year. It is evident that the sludge continued to contribute about the same amount of plant food to the soil, while there was much less fertilizing constituent present on those sections treated with stable manure and commercial fertilizer.

Conclusions—The conclusions to be drawn from the five years' work should be made with caution. The plants were frequently subjected to unfavorable weather and environmental conditions which were difficult or impossible to control. These factors undoubtedly tended to produce erratic results. The following are some of the conclusions which it seems permissible to draw from the experiments in so far as Baltimore sludge is concerned:

1. Neither wet nor air-dried sludge was detrimental to the land. On the other hand, they contributed fertilizing substances to the soil and increased the yield of the six crops planted.

2. Air-dried sludge, when applied in amounts of 20 tons per acre, gave better results than did 40 tons of wet sludge per acre except when used to fertilize sugar corn. Such was to be expected, since, volume for volume, the former material contained from three to five times more nitrogen as ammonia than the wet sludge.

3. Spinach and tomatoes responded least to the use of air-dried sludge.

4. Of the six crops planted, white potatoes, cabbage and sugar corn thrived best. The increase in yield of sugar corn was particularly noticeable.

5. The results obtained with corn and cabbage indicated that sludge continued to give plant food to the soil during the second year after its application. No corresponding observations were made for the four other crops.

The sewage-works are under the general supervision of C. F. Goob, chief engineer of the Department of Public Works, and M. J. Ruark, sewerage engineer. Acknowledgments are due to the agricultural department of the University of Maryland, and especially to those members of the university staff, including Dr. A. G. McCall, T. H. White and J. M. Snyder, who outlined the experiments and contributed toward their successful completion. Valuable suggestions were also given by Prof. J. H. Gregory, consulting engineer to the Bureau of Sewers. The field work was under the immediate control of Edward Cromwell, principal sanitary chemist, and Herman Kratz, Jr., junior chemist, who are stationed at the sewage-works.

Construction of a Water-Works Distribution System

How to Unload Pipe at the Cars, Stock and Haul It, Dig Trenches, Lower, Joint and Backfill and Set Valves and Hydrants and Make Large Taps

By C. L. Ehrhart

Superintendent Water-Works, Council Bluffs, Iowa

Abstract of a paper read before the Missouri Valley Section of the American Water Works Association at its recent convention in Kansas City.

CONSTRUCTION of the water-works distribution system seems to have been given less care in the past than has been accorded to any other part of the works. This has resulted in much trouble cropping out at a later date, often at the most inopportune times. In many cases where the blame for a break has been laid on the pipe, investigation has proved the fault to be poor construction practice. The writer proposes to contribute some of his construction experiences for the benefit of others.

Unloading Pipe From Cars—The first operation is to unload the pipe from the railway cars. Under no circumstances should pipe be allowed to drop or swing against anything that will cause it to crack. It should be unloaded by means of skids or, better yet, by derricks or cranes which can swing it clear of all obstacles and deposit it without undue jar wherever required. For unloading small pipe, the writer has found the best method to be the use of a derrick with a 10-ft. boom, mounted on a heavy truck. This derrick is of a type generally advertised, and is inexpensive to buy and can be used for handling many other things than pipe. If it is not convenient to place the derrick on a truck, it can be mounted on the side of a freight car. As soon as the pipe is lifted from the car it should be sounded for defects, then swung around and lowered. Where the pipe cannot be lowered directly to stockpiles, several lengths can be laid crosswise on the truck back of the derrick and taken over to the stockpile quickly. Probably the handiest and neatest stockpile is one in which the alternate layers are at right angles to each other. Such a pile is not likely to slip, causing breakage or accident, and is handier to check. Many times the pipe can be loaded directly to the trucks or trailers and taken to the point where it is to be laid. In the case of large pipe it is often economical to have the handling done by some company equipped with large stationary booms. In Council Bluffs we are fortunate in having a bridge company which will unload large pipe to our trucks and trailers at $5 per car.

Hauling Pipe to the Job—It is most economical to deliver pipe to the job by a truck pulling a trailer where possible. We have been able to haul from 4 to 5 tons on a single trailer in addition to the pipe on the truck. In removing pipe from the truck or trailer to the ground, care should be taken that there is no chance of breakage. On dirt streets it is possible to slide the pipe off the end without damage, but on paved streets such a practice cannot be carried out. We have found it best to lower pipe on paved streets with the above-mentioned derrick mounted on a truck. As this truck is also used in lowering the pipe into the trench, it is not necessary to string the pipe with the bell ends one way, for it is a small matter to swing a pipe around when suspended from the boom. Sometimes it is not advisable to string the pipe

at all, but to pile it on the parking at convenient locations. In this way it can be stored longer without complaint from the public and without the danger encountered by stringing the pipe in the street. As the pipe has to be picked up by the truck for placing in the trench, the short run necessary to take it from the pile to the trench does not noticeably hold up the work.

Excavation—Some of the larger cities are fortunate enough to have trenching machines, but in the smaller or medium-sized cities I believe most of this work is done by hand. In either case the trench should be dug wide enough to allow the backfilling material to slip past the pipe and fill the lower quarters below the pipe. If a ditch is cramped for width, the backfilling material is likely to rest upon the top of the pipe, causing an undue strain and possible breakage. If the trench is wide enough to allow proper backfilling, it is also wide enough to work in comfortably.

Where it is necessary to go through paving or hard dirt surface, we have found that the cut can best be made with air spades. While it is better to have an air compressor of at least 100 cu.ft. capacity, smaller ones may be purchased and mounted on a truck and driven from the drive shaft. The first compressor used by the writer was made from an abandoned six-cylinder Buick engine mounted in line and driven by another gas engine. The larger compressors should be purchased mounted, or mounted on the running gear of a second-hand truck used as a trailer. To avoid undue jar to the compressor, the running gear should have good springs and at least solid tires if pneumatic tires are not available. All the tools in excavation work should be kept in good condition, and the spades and shovels should be of a light high-grade steel. The best shovels and spades are the cheapest in the long run and, due to their lightness, are not so tiring to the workmen.

The trench which is to receive the pipe should be graded with a string line the same as for sewer work, making the high and low points come at hydrant locations, if possible. This will insure that the sediment can be blown out at the low points and the air taken out at the high points, preventing the line from becoming air bound. Sandy or wet material will require bracing to make the trench safe and allow the placing of the pipe. Water in the trench should be removed before attempting to place any pipe. Gasoline-driven pumps are now so inexpensive that no pipe-laying crew should be without them. Clear water may be removed by motor-driven centrifugals to good advantage.

Where the pipe is handled by derricks or cranes, it is not necessary to keep one side of the trench clear, but it is better to divide the dirt and thus spread the weight on both sides of the ditch. When portable trucks are used, it is possible to lay from ten to twelve lengths per hour, so the bell-holes cannot be dug after the pipe is in the ditch without delaying the work. Under such conditions it is better to put enough men digging bell-holes to insure no delay in the pipe laying.

Lowering the Pipe—With the trench ready to receive the pipe, it is important that the laying proceed as fast as possible. With the portable truck derrick the pipe should be raised with the sling around the middle so as to keep it balanced. As soon as it is clear of the ground the pipe should be given a final sounding to prevent defective or cracked pipe from entering the ditch. The derrick is then run alongside the ditch, the boom swung around and the pipe lowered. In the meantime one man should clean and dry the bell of the last pipe laid very thoroughly, as many defective joints are caused by dirt or foreign matter. When the next pipe is lowered the same man should also clean the spigot end. He should then place a strand of hemp around the pipe and guide it into place when it is sent home. The best hemp, to my notion, is of the dry braided type, and two strands are usually sufficient.

If a derrick cannot be used, the pipe may be lowered into the trench by means of a rope at each end with a rolling hitch, one end of each rope being held under the feet of the men lowering and the other end paid out as evenly as possible so as to lower the pipe without dropping. In this way two men can lower a length of pipe. For sizes too heavy for lowering by hand, a four-legged derrick can be used, or, even better, a large crane or drag-line.

When the pipe is finally placed in the ditch, it should not rest on any solid or unyielding projections, but should lay evenly so that it will not be subject to any strain, as every strain is a potential trouble maker.

Jointing—After the spigot end of the pipe is home and yarned, the joint should be prepared immediately for the joint material, as delay may cause foreign matter to enter. I believe it is best to use a square running rope with a clamp to tighten it up. I have also found it best to seal this running rope against leakage by the use of fireclay rather than ordinary clay. Fireclay may be used over and over again and is not expensive in the long run. After the running rope is sealed, a gate should be built up depending upon the materials used for joint purposes. For heating lead or lead substitutes a kerosene burner is preferable to the use of wood or coal, as it will heat the material quickly and once heated will hold it in readiness for use, insuring against delays caused by cold material.

Joints should be poured continuously. If one pot will not run the joint, additional pots should be in readiness to carry the pouring out with the least break in time. Compressed air-driven joints are better than hand-driven as the lead can be taken up from $\frac{1}{8}$ to $\frac{1}{4}$ in. more than by the hand method without any danger of splitting the bells. Such joints are superior, as the last one driven during the day is as good as the first, whereas the quality of hand-calked joints is likely to lag during the latter part of the day. Furthermore, where the pipe is being laid in large quantities, it is absolutely necessary to calk by air in order to keep up with the laying crew. Sometimes on the larger joints the lead fails to pour evenly, causing a break in the joint, but this may be remedied by calking lead wool into the spot where the break occurs.

Before pouring unavoidably wet joints a quantity of coal oil should be poured into the joint, followed immediately by the lead. In place of the coal oil, lubricating oil or candle shavings may be used with equally good results. It is also a good plan to make a small hole with a knife in the bottom of the joint for drainage purposes. This may allow a little lead to run through, but it will soon "freeze" at the point of drainage and will then pour properly.

Cutting Pipe—Before attempting to make a cut the pipe should be marked at the exact distance from the end by means of a tape or rule. It is then possible to place a running rope or even cloth tape around the pipe at this point, after which the whole circumference of the pipe may be marked very easily. A cross mark should be made to show the starting and ending points of each turn of the pipe. The pipe should then be placed on a

heavy timber with the cutting line directly over the middle of this timber. Starting at the cross mark, a slight cut should be made, using a sledge and hardy. When the cross mark is reached the pipe should be rolled back to the point of beginning, after which a second and heavier line may be cut with the hardy. By rolling the pipe back and starting at the cross mark each time, the strain will be kept equal. Finally the pipe will become crystallized to the point, where it will snap off fairly evenly without projections exceeding $\frac{1}{4}$ in. In making cuts on larger pipe it is a good plan to make the first round with a diamond point, as this removes a considerable amount of the material. Then by following with the hardy, as above mentioned, the pipe will crystallize and crack.

For cutting old pipe in the ditch a special oxy-acetylene torch is the handiest method. It is best to make the first round with the diamond point, as any chalk marks are burned off by the hot flame, while the track made by the diamond point can be readily seen.

Valves—To prevent settling, valves should be placed on a concrete base. We have found concrete from old sidewalks to be ideal for this purpose. All valves should be inclosed. Whether to use boxes or manholes is more or less optional in the small sizes, but valves larger than 12 in. should always have manholes.

Hydrants—In placing hydrants care should be taken that the hydrant is kept far enough back of the curb to clear all automobile bumpers, and it should be set high enough so that the fire department will experience no difficulty in making the hook-up by reason of dirt or snow being too close to the caps. After plumbing, the hydrant should be braced near the top with temporary wood braces to hold it plumb while the backfilling is being tamped in place. The hydrant should have a base of concrete similar to that used for valves, and it is most necessary that the space back of the hydrant to solid ground be filled with concrete to prevent the hydrant from blowing off. No wood should be allowed in these braces, as it will rot and allow the hydrant to push away. At least a bushel or more of brickbats, preferably of soft brick, should be placed around the base of the hydrant to provide drainage and prevent freezing. The writer has never set a hydrant without an auxiliary valve in front of it. The expense is not great and it is justified, as it allows the hydrant to be repaired without interference to service.

Cutting In—To connect new lines at right angles to old lines not provided with tees or crosses, a tap may be made by means of a machine, or by cutting out a section of the pipe and setting in a tee or cross. When made by machine, care should be taken that the split sleeve is centered evenly around the pipe and that there are no defects in the joint. The sleeve should be carefully leveled before the joint is run. After the tee is in place and the joint calked, the machine should be hooked up and the cutting started. The pilot cut is easily made, but the main cut takes considerable labor, and it is of importance that the cutters be sharp and all ground to an even length, otherwise the cutting will be uneven and exceedingly hard to make. After the cut is made and the piece drawn out, the valve should be closed and the machine removed, when the laying of the pipe may proceed in the ordinary manner. In cases where it is necessary to insert a tee or cross, a section of the pipe should be taken out, after which the fitting may be set in place and the opening closed by means of a short length of pipe and a sleeve. Where the sleeve is placed a small section of the pipe is generally missing due to the fact that it had to be cut short in order to enter the bell. Should a valve be placed close to this point and the pressure applied to one side of the valve only, there is a possibility of the valve pushing toward this open space and opening up a joint at the valve. This space may be eliminated by cutting a very short section of pipe and dropping it in the opening before the sleeve is set.

Tees, elbows and plugs must be properly braced against solid earth in a manner similar to the bracing required for a hydrant. If such bracing is not placed, the chances are that the pressure will open up a joint or crack a pipe near the fitting. Sometimes it is necessary to brace back a considerable distance, in which cases the writer has found it very convenient to use old pipe between the fitting and solid earth.

Testing for Leaks—At the completion of each block of pipe a test should be applied to prove that no defective pipe or joints are in the line. Formerly, when central-station pressure was carried for fire service, it was necessary to make a high-pressure service test, but since the advent of the fire department pumper, putting on additional pressure has practically ceased and it is considered safe to rely on domestic pressure. If possible, test plugs should be provided so as to make it convenient for removing the air in the line and also for removing the plug when the test is completed. If test plugs are not available, an ordinary plug may be used with a lead joint shallower than normal. In cases where oxy-acetylene outfits are available, these joints may be melted very easily.

Backfilling—As to relative cost and speed, backfilling by machine, by hand backfiller and team, or by hand, stand in about the order given, but use of a hand filler and team does not cost so very much more than machine work. We have found it best to pile all the dirt over the ditch, and after it is filled to flush the ditch. If this flushing is done from above, the results will be poor and incomplete, as the dirt will wedge part way down in the trench and the bottom of the ditch will not be properly settled. The best method of flushing is to place an 8-ft. pipe on the end of the hose and push this pipe into the ditch until it hits the water main. Then allow the water to flow until it shows up at the top of the ditch, after which the pipe may be moved forward about 10 ft. This method is more efficient and better than hand tamping. We have gone to a hand-tamped ditch and applied the flushing in this manner and caused the dirt to settle several inches. Practically all the dirt that has been thrown out, except that displaced by the pipe, can be replaced by this pipe-flushing method.

Daily Checks and Final Records—The cost of laying a water main should be checked from day to day in order that everybody concerned is fully conversant with the results. The foreman on the job can practically make or break as regards costs. If he is in sympathy with the idea of economy and efficiency and uses his head in planning his work and arranging his men, he can get good results at moderate costs.

With the job complete, a record should be made showing the length, depth, location of specials, hydrants, valves and any other data that might be of value in the future. This record should be placed on a map and filed in a fireproof vault or safe. Card indexes should be made in duplicate showing location of all valves and hydrants, one set being kept in a fireproof place and the other set kept convenient for instant inspection. Unless this is done, the project cannot be called complete.

Erecting 70-Ton Girders With a Derrick Car

Special Counterweight Car Necessary in Placing Eight Double-Track Spans for Pennsylvania at Terre Haute

THE COMPLETION of the Pennsylvania Railroad's new main line bridge over the Wabash River at Terre Haute, Ind., marked the extension into a new field of the erecting car method of placing plate girders. It is believed that never before were 125-ft. deck plate girders weighing as much as 70 tons each erected without the use of falsework. On this bridge the eight double-track deck spans totaling 32 girders were successfully erected in place in 35 working days, including the laying and removing of two temporary tracks. This article describes equipment used and outlines erection methods.

Erecting Cars—Two of the contractor's standard erection cars were used on the job. When these erecting cars were designed, it was realized that they would be called upon in special cases to handle loads much in excess of their nominal capacity. Therefore certain parts, particularly the steel A-frames and main car sills, were increased in section so as to provide enough margin of strength to make possible the use of a special rig when handling exceptionally heavy loads at long reaches.

The standard car is 50 ft. long over the end sills and is equipped with a 50-ft. boom, which is stored for shipment in a boom box passing under the operating platform. The special rig consists of a special boom about 70 ft. long, special rigging and a tail girder. This tail girder is placed in the boom box and takes the horizontal component of the boom stress. Counterweight is secured by connecting the tail girder to the main sills of the erecting car, thus utilizing the weight of the rear end of the car itself, which includes the weight of the hoisting engine and the permanent counterweight placed under the operating platform. The tail girder also projects beyond the end of the erecting car so as to pick up additional counterweight, which is usually placed on a standard flat car coupled to the rear end of the erecting car. On the Terre Haute bridge, however, the use of standard flat cars to carry this counterweight was not satisfactory and the additional counterweight, consisting of 28 tons of pig iron for each erecting car, was placed on a single standard railroad truck as shown in Fig. 2. The tail girder was inserted in an opening

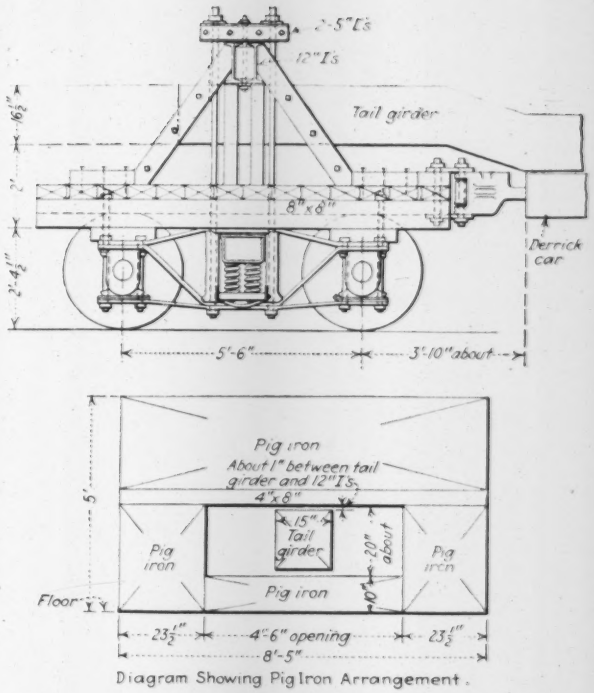


FIG. 2—DETAILS OF SPECIAL COUNTERWEIGHT CARS

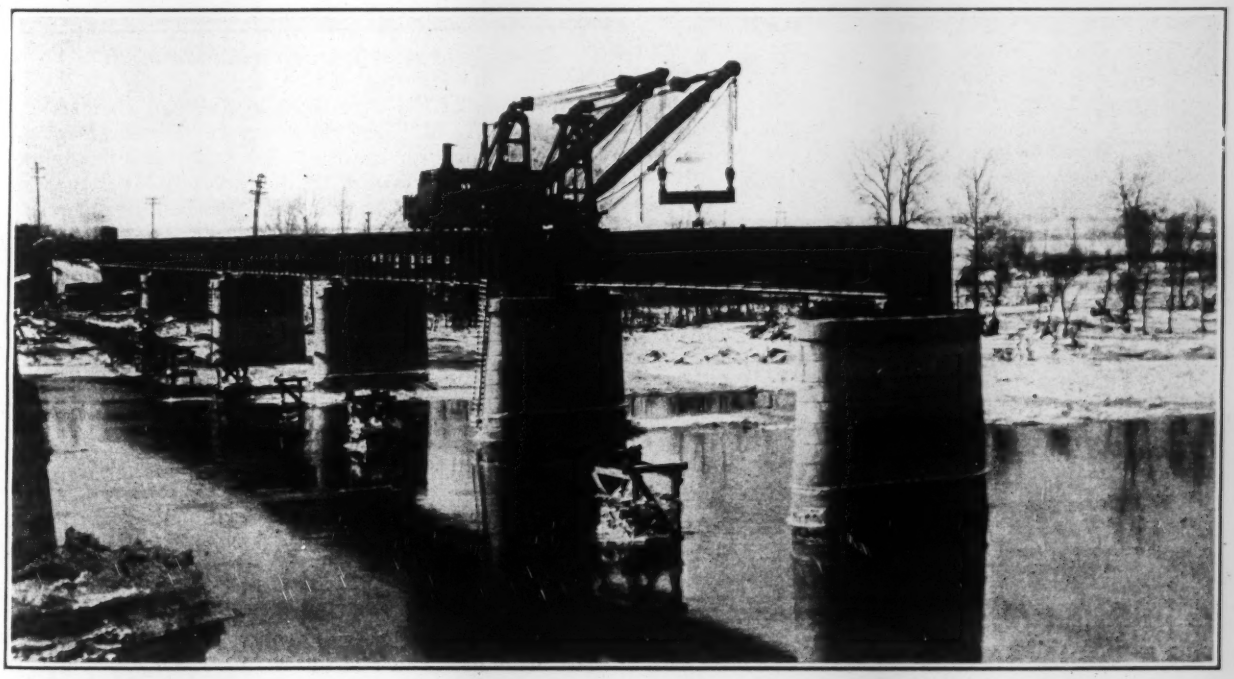


FIG. 1—ERECTING CARS PLACING 70-TON 125-FT. GIRDERS ON TEMPORARY RAIL NEST SUPPORTS

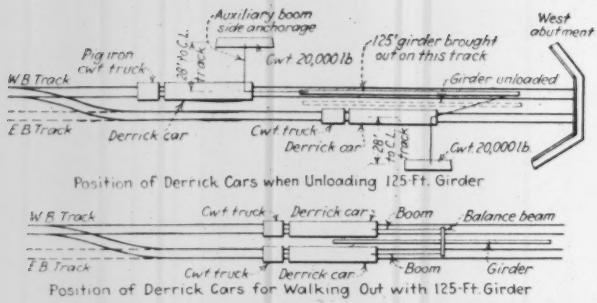


FIG. 3—DIAGRAMMATIC SKETCH OF HANDLING 70-TON GIRDERS WITH DERRICK CARS

in the counterweight sufficiently wide to permit the swing of the tail girder in going around curves.

The erecting cars are self-propelling and capable of traveling with heavy loads suspended from the main boom. They are also equipped with auxiliary booms attached to the steel A-frames on each side of the cars the principal purpose of which is to provide a simple and effective means of anchoring the cars against overturning when heavy loads are swung to one side.

In addition to the special tail girder counterweight, other special equipment for the Terre Haute job included a steel balance beam for dividing the weight of one girder equally between two cars and special girder hitches. These latter were successively bolted to the top flanges of the girders at the center with eight 1-in. diameter heat-treated Mayari steel bolts after cutting out eight flange rivets in the two lines nearest the webs.

Erection—With both erecting cars standing on the eastbound track, the flat cars carrying one 125-ft. girder were pushed in on the westbound track and left standing on the embankment back of the west abutment of the bridge. The erecting cars were then placed in the first position shown in Fig. 3 and the girder was unloaded between the tracks. The empty flat cars were pulled out and the erecting cars placed abreast in the second position shown in Fig. 3. With the booms high, the girder was lifted by the balance beam and walked out until the center of the front trucks were about 5 ft. back of the far end of the last span erected. After blocking the cars, the girder was boomed out until it was in proper position longitudinally over the piers, swung sideways 3.5 ft. and landed on rails carried on blocking previously placed on the piers. The outside girder of a pair was handled first, and, being landed, was jacked out to final position by sliding on the rails. The inside girders were set in final position without sliding.

After the four girders for one span were set, the sway frames and laterals were placed and the shoes inserted. Temporary decks and tracks were then laid and the erection of the next span was begun. The design and construction of the bridge were carried out under the direction of the Pennsylvania Railroad engineering department, I. W. Geer, chief engineer Western region, and J. F. Leonard, engineer of bridges and buildings. The work was performed by the Seaboard Construction Company, Philadelphia, Pa., S. P. Mitchell, president.

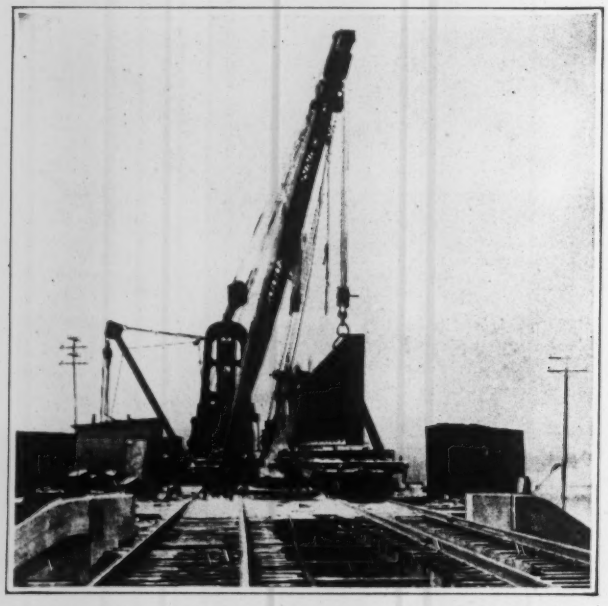


FIG. 4—UNLOADING THE GIRDERS BETWEEN TRACKS ON THE BANK
Note side counterweight on auxiliary boom.

FIG. 5—REMOVING THE BALANCE BEAM

Concrete Cell Blocks Used for Insulation

Concrete cell blocks similar to pumice are being used for insulation in the largest cold-storage building in New Zealand, according to dispatches received by the U. S. Department of Commerce. The process, said to be of Danish origin, involves aeration by whipping of a mixture including portland cement and cow hair plus secret ingredients such as perhaps glue and resin. The material may be cut with an ordinary hand saw. The specific gravity and insulating power may be varied to needs. By regulating the aeration process or by addition of sand, a density anywhere between 15 and 75 lb. per cu.ft. can be produced. It is claimed that blocks of 0.3 specific gravity will bear 100 lb. per sq.in. and building blocks with a specific gravity of 0.9 will withstand as much as 1,200 lb. per sq.in. Completed units will not absorb water.

Mixed Refuse Incinerator for Borough of Queens

Ninth Installation of Same Type Has Capacity of 270 Tons a Day—Loaded Trucks Discharge Into Furnace or Storage

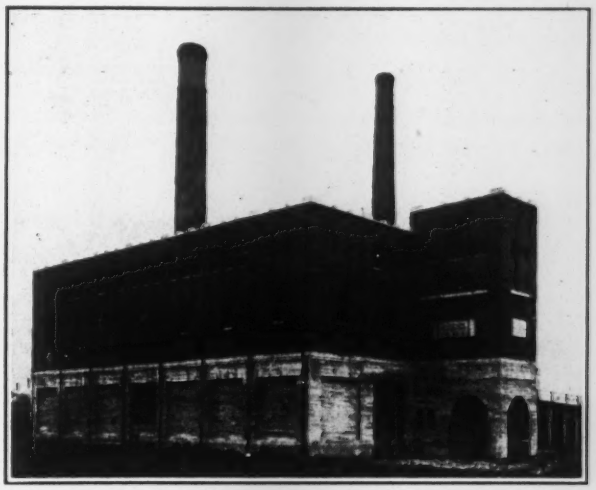
By Joseph C. Woodman
Engineer, Decarie Incinerator Corporation, New York

IN JULY, 1928, an incinerator designed for 24-hour operation with a rated capacity of 270 tons of mixed refuse per day was put into operation in the Astoria section of the Borough of Queens, New York City. It makes the ninth incinerator of the Decarie type built in Queens borough. (For a description of the first one, of 100 tons capacity, built in the Ridgewood section, see *Engineering News*, Sept. 28, 1916, p. 598.) The new plant here described adjoins a 100-ton plant of the same type installed in 1918.

The loaded trucks enter upon the upper or charging floor by means of a reinforced-concrete ramp which widens out at the building to provide ample space for the trucks to turn and back in, either to the charging hoppers or to the storage bins. By this arrangement provision is made for discharging seven loaded trucks at one time, which prevents delay to the collection units.

There are three 90-ton furnaces of the Decarie heavy-duty steel water-jacketed type located on the floor below. Each furnace receives into its suspended water-cooled basket-grate 16 cu.yd. of refuse at one time without affecting the fire on the lower grate beneath the basket. The trucks may be dumped directly into the furnaces through the two 3x4-ft. openings of the charging hoppers, or they may be discharged into the reinforced-concrete storage bins. These two bins hold 1,400 cu.yd. and permit operation of the plant for 24 hours a day. Separate bins are provided so that one bin can be emptied for cleaning at any time. Each bin has a gutter drain its full length, which is provided with heavy removable perforated plates. These gutters lead to a sump located outside of the bin, where solid material can be removed before the water used for washing passes to the sewer.

During the day as occasion demands, and during non-collection hours, the refuse is removed from the storage bins and charged into the furnaces by a 4-ton electric traveling crane equipped with a 2-yd. grab bucket. This crane may be operated at the same time that trucks are on the charging floor, insuring a constant uniform feed.

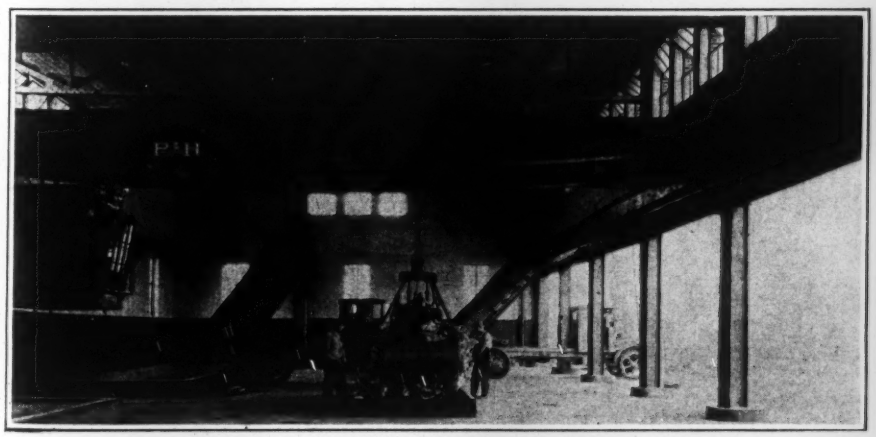


GENERAL VIEW OF ASTORIA INCINERATOR, BOROUGH OF QUEENS, NEW YORK CITY

On the first, or operating, floor, which is 4 ft. above the ground, are located the three furnaces with their individual firebrick-lined steel-incased gas combustion chambers, preheaters and both forced and induced draft steam-driven fans. The furnaces embody the distinctive principle of this special type of unrestricted upward combustion of the refuse, the wetter material being dried out in the suspended water-cooled basket grate before dropping to the lower grate, where final burning takes place. These furnaces require much less stoking than other types and the working conditions of the firemen are much less severe. There are no firebrick in the furnace subject to extreme strains caused by wet refuse coming in contact with hot brickwork.

The lower grates of the furnaces are of heavy cast iron of the cantilever dumping type operated by ratchets and worms on the outside of the ashpit fronts. When cleaning of the fires is necessary, it can be accomplished in a few minutes with a small amount of effort on the part of the firemen. The grates are dumped, discharging the ash and clinker into the firebrick-lined pits beneath each furnace. As soon as the grates have been brought back to position, dried refuse is stoked down from the basket grate above, where burning has been going on all the time. Operation continues practically without interruption. The cleaning of fires causes no heat or dust on the furnace floor and the grates can be dumped without opening the stoking doors of the furnace.

The hot clinker and ashes may lie in the ashpits with the forced draft passing over them to cool them and are then discharged through duplex self-locking gates into the ashcars beneath the pits, the dust being drawn back into the pits by the draft. The loaded ashcars are then run over a narrow-gage track to the automatic electric platform skip hoist. The loaded car is run onto the plat-



CHARGING FLOOR OF ASTORIA INCINERATOR
One truck is emptying into storage bin and one is charging a furnace.

form of the hoist, eliminating the need of dumping the ashes into a bucket with the attendant dust and heat. A button is pushed and the loaded car is hoisted and dumped into an overhead concrete ash storage hopper and returned to the basement automatically.

The ash storage hopper will hold the ashes for 24-hour operation. The same trucks that bring the refuse take the ashes away by driving beneath the hopper and receiving their load through a large duplex self-locking gate in the bottom of the hopper.

The ceiling of the ash tunnel is 9 ft. high and windows are provided. The air supply for the forced draft fans is taken from the ceiling of the tunnel and working conditions for the men are exceptionally good. From the furnaces the flames and gases of combustion pass into the combustion chamber provided for each unit where high temperatures are maintained and the combustion completed.

The 13½-in. firebrick work of these chambers is incased in a steel plate casing $\frac{3}{16}$-in. thick, which has ample steel channel buckstays and stiffening angles riveted on the outside. These chambers are of sufficient size to allow the gases to expand and reduce their velocity, and necessary baffle walls and settling pits are provided to obtain destruction of odors and the collection of dust particles. These pits are provided with cleanout doors in the ash tunnel so that the dust may be removed directly into the ashcars.

In the rear portion of these chambers is located a preheater or regenerator for heating the forced draft supply, thereby returning to the primary furnace a large portion of the waste heat that would otherwise pass up the chimney. The preheater is of unique design allowing gases with a temperature of as high as 2,500 deg. F. to pass through without damage. The preheater is built of special patented interlocking refractory fire tile with the hot gases passing through horizontal passages and the air from the forced draft fan entering at the top and passing down through vertical passages to the ducts beneath that lead to the ashpits. The air is heated in this way to a temperature of from 350 to 500 deg. F.

To the rear of the preheater is located a direct pass to the breeching provided with a guillotine-type damper and also there is provided to one side an induced draft fan which may be used when occasion demands to insure good draft during bad atmospheric conditions. All the fans are driven by steam engines and the furnaces supply much more than enough steam power to drive these fans and to furnish the electric power for operating the crane and ash hoist and lighting the plant.

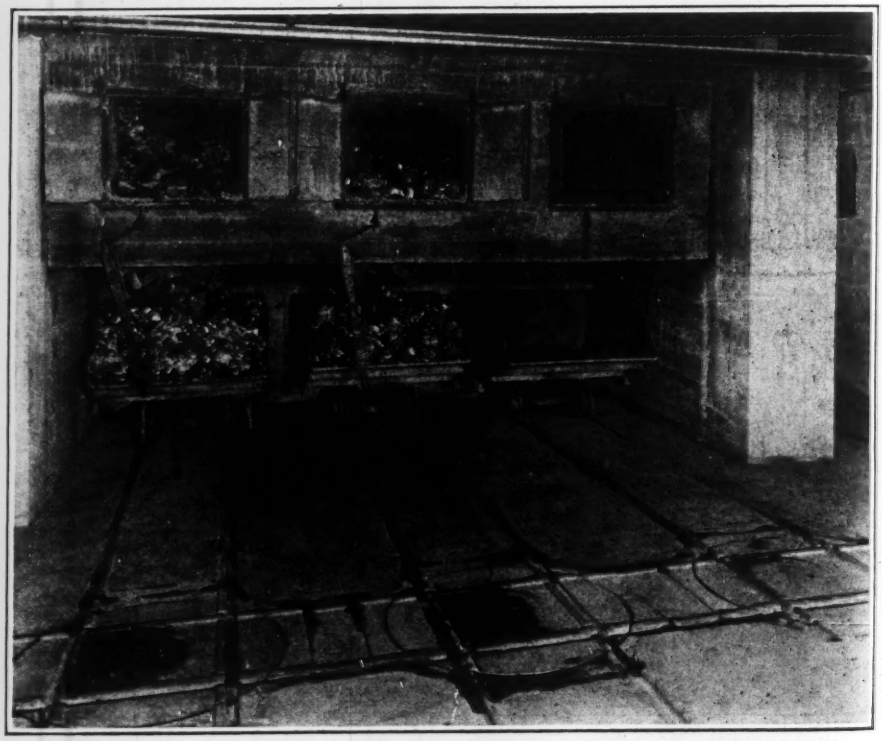
The breeching leading the gases to the chimney is constructed largely beneath the floor of reinforced concrete and lined with 9 in. of firebrick to the inside of the chimney. The chimney is of red radial brick construction 150 ft. high with an internal diameter at the top of 8 ft. and it is lined for the full height with an independent self-supporting firebrick lining laid in high-temperature cement.

On a concrete platform beneath the ramp is located a vertical hydraulic baling press which is operated by a steam-driven high-pressure pump located within the building. A bin is provided adjacent to the press with an opening at the charging floor level for large tins such as washtubs, large tin cans, etc. The baling press has a box 24x48 in. in plan and 10 ft. deep, which operates at a pressure of 3,000 lb. per sq.in. on an 8-in. diameter cylinder exerting a pressure of 150,000 lb. to form a 24x48x36-in. bale. This press is provided to reduce the volume of this incombustible material. An electric driven 1-ton trolley hoist is provided under the ramp for handling these finished bales.

The building housing this equipment is of substantial fireproof design built of brick, concrete and steel. Ventilation is provided on four sides of the building, using steel sash with a maximum amount of openings. The interior of the building above the basement is painted with light gray cement paint with dark green wainscot. Men's room and office are provided with steam heat, showers, lockers and toilets. Many hose connections are located throughout the building and the plant is kept clean by systematic washing. There is practically no odor within the buildings, for the storage bins are emptied each night and are frequently washed out and disinfected.

The plant is guaranteed to operate without the use of fuel when burning a mixture of 70 per cent garbage and 30 per cent rubbish, by weight. This condition, as well as others, such as capacity and freedom from nuisance, were met both on the acceptance test and under operation by the city.

The incinerating and mechanical equipment was furnished and installed by the Decarie Incinerator Corporation, New York City.



LOADING CARS FROM ASHPITS BELOW FURNACE

Traffic Observations on the Peace Bridge

International Structure Has Unusual Problems in Management and Traffic Control—Preliminary Traffic Estimates Exceeded Slightly in First Year—Terminal Planning Controls Capacity

By R. W. Cady
Superintendent, Buffalo & Fort Erie Bridge Company

TRAFFIC figures are now available for the first year of service of the Peace bridge across the Niagara River, connecting Buffalo, N. Y., with Fort Erie, Ont., which was placed in service June 1, 1927. That the results of the first year of operation are of engineering interest is proved by the frequency with which requests are received for information on the subjects of traffic density, control and fluctuations. An analysis of the figures on hand reveals much valuable information to those interested in toll-bridge projects.

At the Peace bridge the situation is complicated by the international character of the structure, necessitating elaborate terminal facilities to prevent congestion. Each vehicle crossing the bridge must not only stop to pay toll but is also subjected to examination by customs and immigration officials of the United States or Canada.

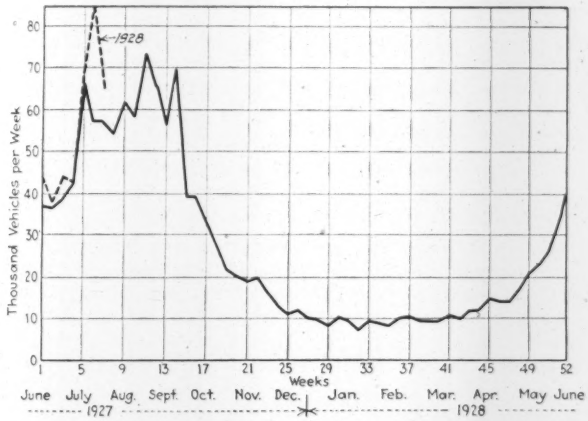


FIG. 1—PEACE BRIDGE TRAFFIC BY WEEKS SINCE OPENING JUNE 1, 1927

Provision was made in the original design for a maximum traffic density of 1,500 vehicles per hour in each direction, a figure already exceeded. The saturation point is determined by the customs and immigration facilities, rather than by the capacity of the 36-ft. roadway. Figs. 4 to 7 show this very clearly. All four views were taken at different parts of the bridge, with traffic flowing at the rate of 1,550 cars per hour, on July 4, 1928, the day of maximum use to date. It will be noted that practically all the cars at this time were northbound. Observations on this date lead to the conclusion that the maximum possible capacity of the bridge is 1,800 northbound cars per hour and 1,400 southbound. As the two streams use separate entrances and exits, there is no reason why these two figures should not be reached simultaneously, although present travel habits make this unlikely to occur. The difference between the two figures is due to the fact that the customs and immigration procedure is a trifle more cumbersome in one direction than in the other.

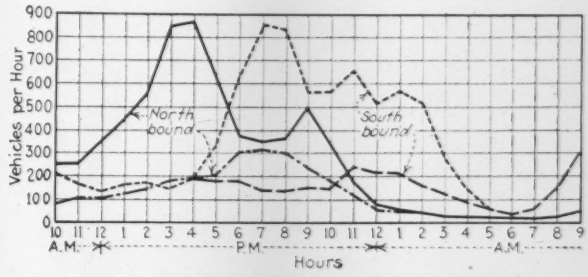


FIG. 2—MAXIMUM AND MINIMUM TRAFFIC, JUNE 23-JULY 5, 1928
Showing effect of bad weather and holidays.

Traffic Characteristics—Because of the proximity of Niagara Falls, the popularity of certain summer resorts on the north short of Lake Erie and the small amount of international truck traffic, pleasure cars predominate. The number of trucks crossing the span averages only 50 per day. About 24 per cent of the cars may be classified as tourist traffic, as they come from outside the two counties in which the bridge is situated. The seasonal fluctuation is large (Fig. 1), and it is generally considered that traffic due to business is roughly measured by the number of cars crossing in the winter, the excess summer traffic being classified as for pleasure. In the long run the number crossing in each direction is about equal, although any one day may not balance. Northbound traffic reaches its peak earlier in the day than that bound south, as is shown by Figs. 2 and 3. The maximum density occurs on Saturdays, Sundays and holidays, as might be expected. All previous records were broken July 4, 1928, when 10,966 southbound and 9,940 northbound cars crossed the bridge. Between 1 and 2 p.m. 1,608 cars passed from the United States to Canada, but less than 150 crossed in the opposite direction during the same hour. A maximum of 1,245 southbound cars has been handled.

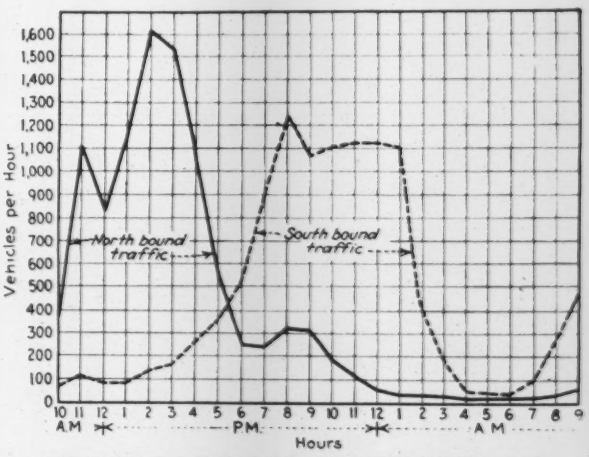


FIG. 3—DAY OF MAXIMUM TRAFFIC, JULY 4, 1928

Customs Procedure—Temporary visitors who intend to return by the same route simply leave the registration card of the car with the customs officials, picking it up upon their return. Those who intend to stay longer or to return by a different route find it necessary to fill out a detailed form giving a complete description of the car and the number of passengers. This is handled in a separate line in order to avoid delaying the regular traffic.

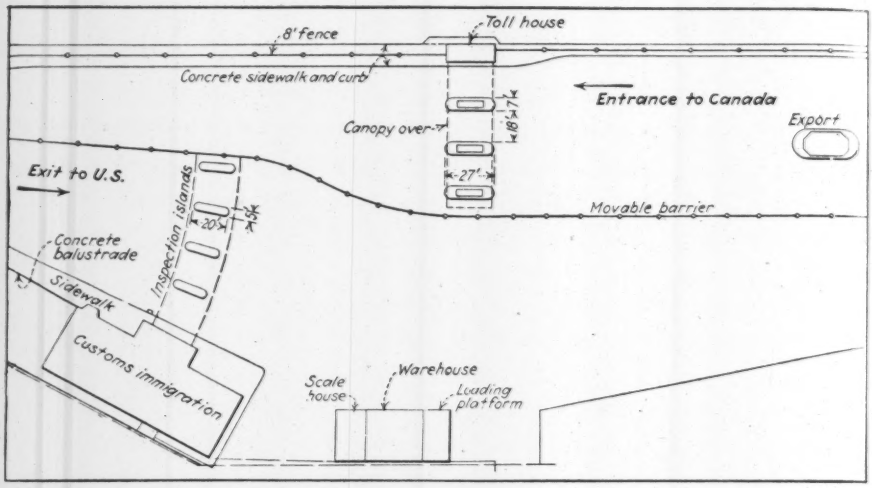
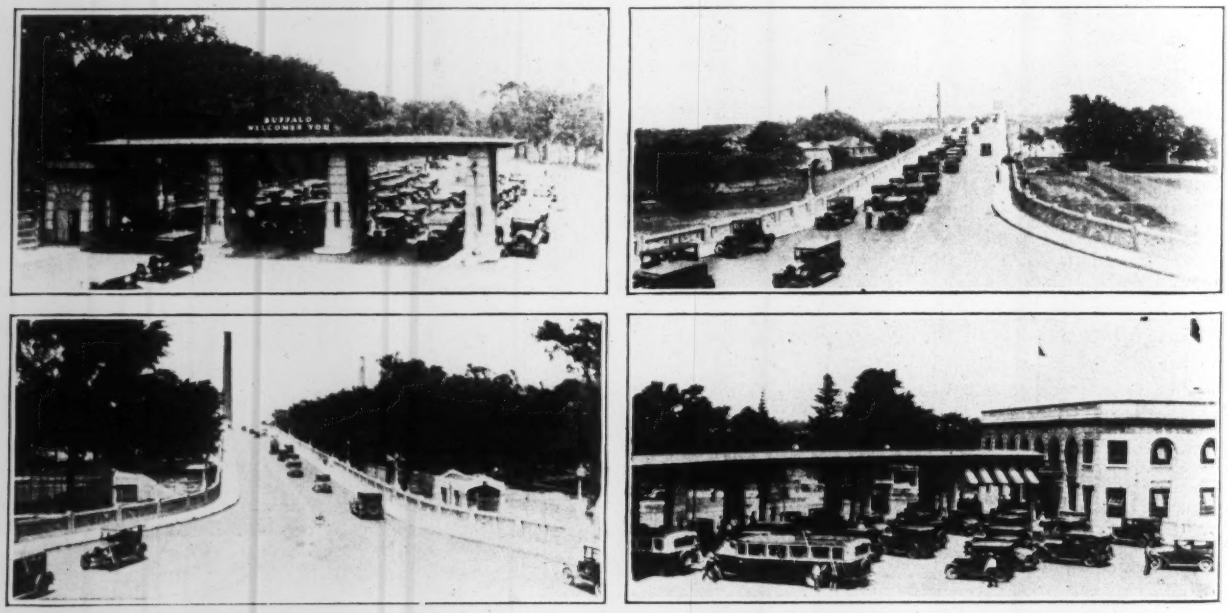


FIG. 8—AMERICAN TERMINAL OF PEACE BRIDGE

Financial Results — The Peace bridge was built and is operated by the Buffalo & Fort Erie Public Bridge Company, which issued bonds to secure funds for construction. It cost a little more than $4,600,000. Provision is made for its conversion to public ownership after the tolls have returned the original investment. Toll rates are the same as were charged on a ferry line in operation before the bridge was built and are based upon the wheelbase of the car, plus an additional charge of 5c. for each passenger. Buses pay 10c. per passenger, and trucks are rated upon a load capacity basis varying from 35c. for a light ½-ton truck to $2 for a loaded 7-ton truck. During the first year of operation the charge averaged approximately 38c. per passenger car. Pedestrians pay 5c. each. Although the wheelbase system is rather cumbersome, it is found that the ticket sellers soon become familiar with the standard makes of cars. They are provided with measuring sticks for use when in doubt.

Preliminary estimates of probable traffic were based upon a study of traffic on the ferry already mentioned, modified by figures obtained from existing bridges at Niagara Falls 20 miles away. It was evident that the ferry, which carried 350,000 cars per year, would have done more business had facilities been available, so the estimate of the first year's traffic was placed at 1,250,000 cars, yielding an income of $500,000. As a matter of fact, during the first year of operation 1,407,272 vehicles crossed the bridge, and the income was approximately $580,000. Bus transits totaled 48,286, carrying 411,415 passengers. Pleasure cars carried 2,477,946 passengers besides the drivers. The two 6-ft. sidewalks were not opened until November, 1927, but from then until June 49,305 pedestrians crossed the span.

Terminal Facilities—The arrangement of ticket booths and governmental inspection stations is shown in Figs. 8 and 9. Northbound cars purchase tickets from one of the seven lines at the Buffalo end of the bridge, and tickets are taken up and customs and immigration inspections passed in nine lines at the Fort Erie end. Buses and through travelers are handled separately. Cars



FIGS. 4 TO 7—PEACE BRIDGE CARRYING 1,550 NORTHBOUND CARS PER HOUR
Upper left—Toll booths at Buffalo. Upper right—Approaching Canadian side. Lower left—Entering bridge. Lower right—Customs and immigration inspection.

bound in the opposite direction follow the same general procedure at entirely independent terminals. A ticket seller can handle about 220 cars per hour, and a pair of customs and immigration inspectors can pass three or four cars per minute.

Organization—An international bridge must be conducted contrary to the first principle of successful organization. Although apparently operating as a unit, it is in reality functioning under five distinct controls: the bridge company, which collects tolls, maintains the structure and directs traffic, and the customs and immi-

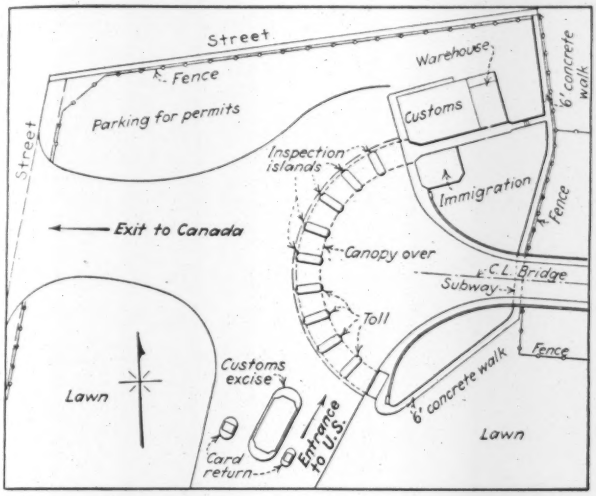


FIG. 9—CUSTOMS AND IMMIGRATION INSPECTION STATION ON THE CANADIAN SIDE

gration authorities of the two countries. Close co-operation is necessary; if any one department breaks down, a traffic jam results. Regulations forbid interchange of personnel, even in emergencies. The forces of the bridge company are comparatively flexible, but the government inspectors are under civil service control with fixed rules and no provision for overtime. When it is considered that 16,000 cars may cross the bridge on one day and 6,000 the next, the complexity of the problem is apparent. It takes very little delay to form congestion—holding up 200 cars will form a line a mile long. During the summer months operation of the bridge requires about 100 men. This force is divided about as follows: U. S. customs, 13; U. S. immigration, 12; Canadian customs, 25; Canadian immigration, 12; bridge company 38.

The bridge company provides and maintains quarters for the government employees but does not, of course, pay their salaries.

Except for the construction of a short exit street, no special provision was made in Buffalo to accommodate bridge traffic. As the city streets are of ample widths, no unusual congestion is caused. In Fort Erie several new streets were opened, and more are in process of construction to provide for future increases in traffic. Figures for the portion of the second year now available show a decided increase in traffic.

New York Breaks Highway Record

The New York State Department of Highways had a record year in 1928, according to A. W. Brandt, commissioner. During the year 645.80 miles of pavement was laid, or 7,727,484 sq.yd. This compares with 645.03 miles, or 7,686,468 sq.yd., in 1927.

Texas Railway Completes New Through Route

Extension Opens Line Between East and West Texas—Heavy Work to Reach Flat Staked-Plains Country

RECENT extensive railway developments in Texas include a short but important extension of the Quanah, Acme & Pacific Railway from MacBain west to Floydada, 28 miles, which was opened to traffic on Oct. 1, 1928. This extension serves what is known as the South Plains district and forms a link completing a new route from this district to Oklahoma City which is 90 miles shorter than any other route. The South Plains district of northwestern Texas, known also as the Staked Plains, has had a rapid agricultural development in the past few years, producing cotton, wheat and livestock. Besides this outgoing traffic, a large amount of lumber for construction work in the towns and farms is shipped in over the new extension. Figs. 1 and 2 are views along this line. Fig. 3 shows the railway and its connections.

In 1910 the original line of Quanah, Acme & Pacific Railway was built from a connection with the St. Louis-San Francisco Railway and the Fort Worth & Denver City Railway at Quanah, Tex., southwest to Paducah, 43 miles. With the development of the northwest or panhandle section of Texas an extension became desirable, and a number of preliminary lines were run west from Paducah, at El. 1,910, to find an economical route reaching the top of the cap rock, or eastern ledge of the plains district, at about El. 3,366. The country between these points is generally rolling, becoming rough toward the cap rock, and it is cut up by deep ravines and canyons. From these surveys, which extended to various points within a distance of 30 miles along the cap rock, it was found that the most economical line would be that ending at MacBain, and in 1913 the railroad was extended to that place, a distance of 40 miles. The new extension now connects with the Atchison, Topeka & Santa Fe Railway at Floydada, thus completing an east and west line, as shown by the map, Fig. 3.

Topography—From the profile, Fig. 4, it will be seen that for the first 9 miles this extension is on a continuous grade of 1 per cent, compensated for curvature and with maximum curves of 4 deg. This part of the line involved heavy construction work, with high fills crossing the canyon and heavy rock cuts about 35 ft. deep. The largest fill is 60 ft. high and contains 87,000 cu.yd. Beyond this 9-mile stretch the line is wholly on the plains, a flat territory rising at about 10 ft. to the mile (see Figs. 3 and 4). There are no watercourses, but the country is dotted with depressions, called lakes, in which runoff water collects during the rainy seasons. Across this country the line is composed of two practically equal tangents, neither of which comes within the high-water lines of these lakes.

Track and Structures—A roadbed width of 20 ft. is provided on high fills and 24 ft. in cuts. On the plains the fills have an 18-ft. top and are given a minimum height of 3 ft. to insure adequate drainage. Track is laid with 75-lb. rails and is ballasted with a 8-in. minimum of coarse gravel obtained on the right-of-way. There are no trestles or steel bridges, the larger waterways being taken care of by concrete box culverts and the smaller ones by concrete pipe. Water stations have

60,000-gal. steel elevated tanks. For livestock traffic one 40-car stockpen and two 20-car stockpens were built, all equipped with double chutes so that two cars can be loaded at once. Cotton-shipping platforms have a standard size of 60x140 ft. A combination freight and passenger station of timber construction was built at Dougherty, and another of brick at Floydada. Right-of-way fencing consists of five lines of barbed wire on creosoted pine posts, with wire stays between the posts. The railroad company built and owns its telephone line for train dispatching, using No. 9 copper wire on 20-ft. creosoted pine posts spaced 30 to the mile.

Construction Work—For the grading, the contractor's original plan was first to top the cuts, or excavate the cuts as deep as possible, with elevating graders handled by caterpillar tractors, hauling the material with dump wagons, and then to take out the bottoms with revolving power shovels. With unexpected sub-soil conditions, however, it was frequently the case that only a few feet of the cut could be taken out with the graders, it being necessary then to use the power shovels for the greater part of the excavation.

Three classes of material encountered under the top soil forced this change in plan: (1) Heavy blow or sugar sand, which made pulling and hauling so heavy on the teams that it was found absolutely necessary to replace the tractors and graders with shovels, so that the wagons could be loaded on the banks, where the hauling was comparatively easy. Even then, the material was very disagreeable to handle because of the dust which came from it, handicapping machine operators and playing havoc with the bearing and other working parts of the equipment; (2) a very hard caliche or adobe rock which the elevating graders could not handle, and even with the power shovels it was necessary to do heavy shooting to get out a part of material; (3) another type of adobe rock was encountered in a number of cuts which required shooting from the very top, but these cuts were taken out entirely by the shovels, the material being hauled out partly by dump wagons and teams and partly by trucks. However, the construction of these last cuts was planned originally in this manner.

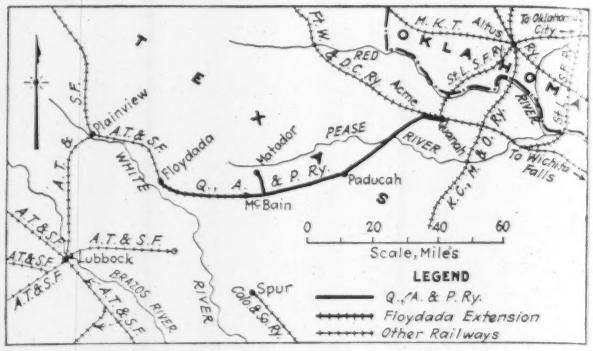


FIG. 2—THE QUANAH, ACME & PACIFIC RAILWAY, TEXAS

Construction of the larger fills—that is, those which were both high and long—was favored particularly by the nature of the side hills forming the ravines across which the fills were to go, since the slopes were long and rolling and the soil was of a type that worked well with the elevating grader. This enabled the contractor to establish a series of borrowpits at various rises of the fill, thereby keeping the hauls short, while at the same time practically eliminating any climbing for the teams.

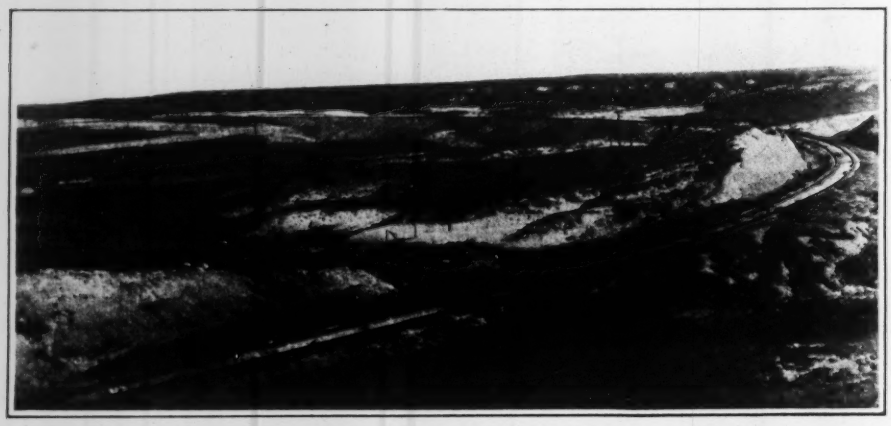


FIG. 1—ON THE FLOYDADA EXTENSION, Q., A. & P. RAILWAY
Line on 1 per cent grade to reach the flat country of the South Plains. Near mile 47 on profile.

Tracklaying and Ballasting—For this work, which was included in the contract and provided for 75-lb. relay rails, a material yard was established and the simplest possible equipment was devised. A car for rails was equipped with a set of dollies to be attached to the side in unloading. On this car were loaded rails for 2,200 ft. of track and a sufficient supply of spikes, bolts and small material. In loading the rails they were turned alternately, so that the good side of the head would be inward. This car, with enough cars of ties for a half-day's work, was hauled to the front by a locomotive rented from the railroad.

At the front, when the topography permitted, a caterpillar tractor was used for the actual laying of rails, while a locomotive with a few cars distributed ties for

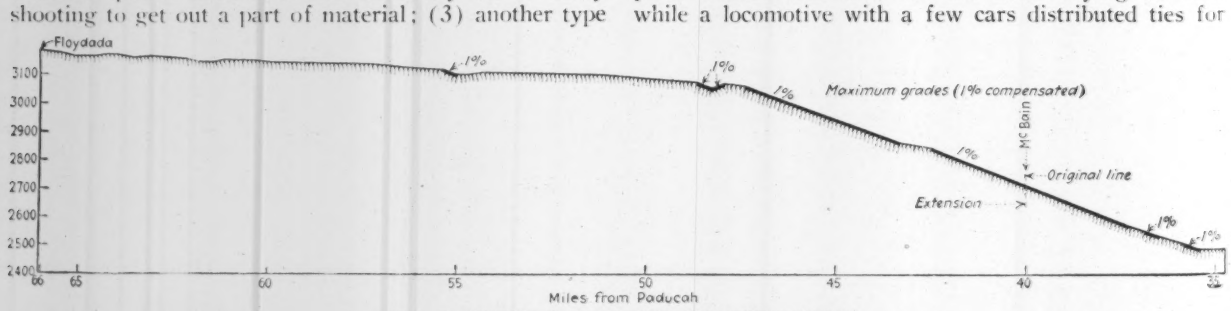


FIG. 3—PROFILE OF FLOYDADA EXTENSION

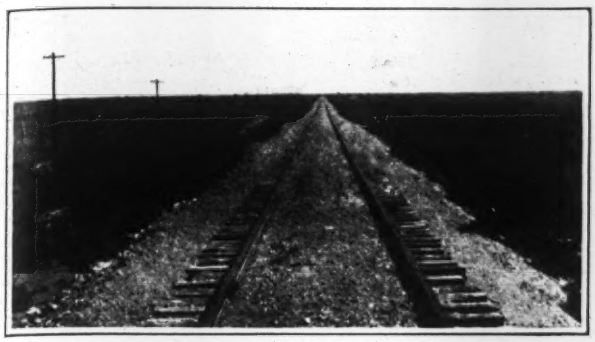


FIG. 4—TYPICAL TRACK ACROSS THE STAKED PLAINS

full tieing behind. Ties were carried ahead on motor trucks in sufficient numbers to halftie the track. As the steel car came along, successive rails were thrown onto the dollies, rolled forward, caught and then carried into place by twelve men with rail tongs. The rails were bolted and bridles were placed to hold the gage while the steel car passed over, spiking being done behind the train. Tracklaying was followed closely by earth surfacing on the first 8 miles, which included track to the top of the cap rock. From that point to Floydada the track was ballasted from the gravel pit, which was located in one of the cuts below the cap and which proved to be ideal material for the purpose. The one difficulty encountered in the ballasting was due to inability to secure center-dump ballast cars. It was necessary to use a type of coal car which permitted the ballast to flow onto the track in irregular quantities, so that much of it had to be shifted later with push cars.

Engineers and Contractors—The Floydada extension was built under the direction of Charles H. Sommer, president, and A. F. Sommer, chief engineer and general manager, of the Quanah, Acme & Pacific Railway, with C. Hilliard as assistant engineer at the front. Stations and other buildings were built by the George P. Reintjes Company, Kansas City. The general contractor for grading and tracklaying was the Lone Star Construction Company, San Antonio, J. H. Montgomery, superintendent.

Testing Wearing Qualities of Stone Flooring

There is a growing tendency to use marble, slate, limestone, and similar materials of different colors in the floors of high grade buildings. By proper selection of color, attractive designs in the floors may be secured. Materials used for the various colors, however, do not always have equal resistance to wear and for that reason trouble has been experienced with unequal surfaces. An example of this is in the Union Station at Washington, where a hard red marble has been combined with a much softer white marble. The heavy traffic on many parts of this floor has caused uneven wear, leaving the tiles of the red marble standing so much above the white marble that resurfacing will soon be necessary.

The Bureau of Standards has developed apparatus for the purpose of testing the abrasive hardness of various flooring materials of this nature. A series of tests are now being made to determine whether the use of the apparatus will afford a reliable criterion for comparing different flooring materials, so that future selections can be made with a reasonable assurance that uneven wear will not result.

Unique Contract for Design of Sewage-Works for New York

Plans for 180-M.G.D. Activated-Sludge Plant to Be Made by Fuller and McClintock for $605,000 Including Consultants' Fees

A CONTRACT for engineering services in design and consultation unique in character and notable because it marks the beginning of the execution of a program for high-degree treatment of the sewage of portions of New York City was executed on Nov. 30 between Fuller and McClintock, consulting engineers, New York City, and the president of the Borough of Manhattan. The contract provides for plans, estimates, specifications, and contract forms, including the services of specialist consultants, for an 180-m.g.d. activated-sludge plant on Wards Island, in the East River, for treating portions of the sewage of portions of the Boroughs of Manhattan and the Bronx, comprising an estimated population of some 20 per cent of the population of the whole city. The contract price, which is $605,000, also includes consulting services of Fuller and McClintock on the hydraulics of the intercepting sewers in the two boroughs and the tunnels therefrom beneath the East River to Wards Island, in relation to the hydraulics of the treatment plant. The contract also provides for special services in design and consultation as regards architectural, landscape, mechanical, electrical, and sludge vessel design. The contract states that the plant shall have "an average capacity of not less than 180 m.g.d. average flow" and "shall be designed to remove not less than 90 per cent of total suspended matter and not less than 95 per cent of total bacteria." The works, "when in operation, shall be free from nuisance due to obnoxious odors, gases and dusts."

General plans and reports for the entire project must be completed by the engineers within three months. These general plans are subject to modification at the request of the borough president. The entire agreement is subject to termination by the borough president in case (1) His requests, if any, for amendment are not carried out by the engineers within six weeks, and (2) if "in the opinion of the president, the cost of the treatment works will exceed $20,000,000." It should be added that in an earlier and preliminary report by George W. Fuller, the cost of the treatment works was put at $18,500,000, which was an increase of $1,500,000 over a tentative estimate made late in 1927 by an engineering advisory committee consisting of Arthur S. Tuttle, chief engineer, Board of Estimate and Apportionment; C. M. Pinckney, chief engineer, Borough of Manhattan; Edward W. Wood, deputy chief engineer, Borough of the Bronx, and Clifford B. Moore, consulting engineer, Borough of Queens. An estimate of $12,500,000 made by this committee as the cost of intercepting sewers and tunnels was approved by Mr. Fuller in the preliminary report named.

The contract with Fuller and McClintock details the works to be designed by them, the contract payments for each group, and the time for delivery of working drawings and specifications, all of the periods dating from the signing of the agreement (Nov. 30, 1928):

General project plan and report, $135,000; 3 months. Aeration tanks and dock, and galleries, $90,000; 3 months. Preliminary and final treatment works, and connecting conduits and outfall, $50,000; 12 months.

Pumps, blowers, air conditioners, etc., $30,000; 12 months. Substructures for pumps and blower plant, installation of machinery and apparatus, etc., $140,000; 20 months. Superstructures, $75,000; 20 months. Miscellaneous works, $40,000; 24 months. Sludge vessels, $10,000; 24 months. Fertilizer plant, $35,000; 30 months, unless the borough president directs the elimination of this feature.

The fertilizer plant is to be of only 50 tons capacity, and, if built, will be for the purpose of working-scale demonstrations of reducing the excess sludge from the activated-sludge plant to a commercial fertilizer. The plans will provide for barging all of the sludge, minus any that may be delivered to this possible demonstration plant, to sea by means of "self-propelled seagoing sludge vessels of ample capacity" to carry to sea daily not only the excess sludge but also the screenings removed from the sewage before it goes to the main plant.

The contract states that it is proposed to use electricity as the motive power at the activated-sludge plant; also that agitation for purposes of activation is to be "accomplished by compressed air or other means." For news articles dealing with the general Wards Island project for a period of five years, see *Engineering News-Record*, Aug. 30, 1923, p. 364; Dec. 8, 1927, p. 935; April 19, 1928, p. 641; and May 17, 1928, p. 793.

Engineering News-Record is informed by Mr. Fuller that specialists for various portions of the plant have been engaged by his firm as follows: General design, with particular reference to the activated-sludge process, Pearse, Greeley and Hansen, Chicago; power plant, Will J. Sando, Milwaukee; barges, Cox and Stevens, New York City; architectural design of buildings, Sloan and Robertson, New York City. Landscape work, Noel Chamberlin, New York City. Also that construction work will be executed under the direction of the president of Manhattan Borough, in a bureau headed by Richard H. Gould, under C. M. Pinckney, chief engineer, Borough of Manhattan. Mr. Gould was for many years principal assistant engineer to James H. Fuertes, New York City.

Letters to the Editor

Wear of Brick Pavement Under Heavy City Traffic

Sir—My attention has recently been called to an article entitled "Wear of Brick Pavement Under Heavy City Traffic," by P. L. Brockway, city engineer, Wichita, Kan., in the Aug. 23, 1928, issue of *Engineering News-Record*.

Mr. Brockway makes a number of erroneous statements regarding the accelerated traffic tests on paving brick conducted by the Bureau of Public Roads at Arlington, Va., and on these bases the statement that "one is forced to the conclusion that the translation of the wear per vehicle to condition of street or highway service was unwarranted and that actual service tests will not support it."

As one of the authors of the report of the Arlington tests to which Mr. Brockway refers at length, I feel it my duty to show that the charge made is not based on facts.

In the opening paragraph of the article referring to the Arlington tests it is stated that "one conclusion drawn was that the traffic, and presumably the wear and breakage of brick by the passing vehicles, were equivalent to fifteen or twenty years on the heaviest traveled highway in Cook County, Illinois." There is no such conclusion in the report of these tests. No attempt was made to draw a conclusion on this point. A comparison was made, however, and the statement made in the report reads that "in terms of total tonnage the test traffic is equivalent to five years of traffic on the most heavily traveled of these important motor arteries," and as brought out clearly in the report this refers to truck traffic alone.

Following the author's description of the wear of the brick pavement in Wichita, there are four specific criticisms of the Arlington tests. I shall discuss these in order.

The first states that "the brick were obviously picked with the greatest care to obtain the most perfect specimens, having extremely uniform color, size, shape and toughness." I was in charge of these tests and know this was not the case. An effort was made by the manufacturer to produce brick which would be of uniform quality throughout the range of sizes. No attempt was made to produce a product of superlative quality, however. The only way in which the uniformity of the brick can be judged is on the basis of the data from the physical tests given in Tables III and IV of the report, and upon these data we based the statement that "the brick used in the test pavement were of about average quality."

The second states that "the pavement was laid to the highest degree of smoothness and even bearing." The base was smooth, having been used for another purpose, but the actual construction was done by a contractor using his own men and methods and there was nothing extraordinary about the perfection of the job. The application of the filler was extremely bad due to weather conditions. All of these comments appear in the report.

The third states that "the curves in the test road were superelevated to keep the center of gravity of the load over the center of support. . . ." All of the traffic not equipped with chains ran at a speed greater than that for which the track was superelevated, and the effect of this overturning moment was discussed in some detail in the report. When the heavy chains were applied to the wheels, the speed of the trucks was reduced to about that for which the pavement was superelevated. The heavily loaded trucks could not be driven any faster.

Fourth, in speaking of the fact that the speed was uniform and the track level, the author states, "The net result was little more severe than a straight rolling contact between rubber and brick." As the report shows, approximately one-third of the heavy truck traffic was carried by wheels equipped with extremely heavy anti-skid cross-chains, a photograph of which was included. There was nothing akin to straight rolling contact in this portion of the traffic.

Washington, D. C.
Nov. 3, 1928.

L. W. TELLER,
U. S. Bureau of Public Roads.
Senior Engineer of Tests.

Further Instances of Use of Artificial Turbidity for Algæ Control

Sir—The writer is very much interested in the article, "Algæ Control by Creating Turbidity at Louisville, Ky.," in *Engineering News-Record*, Oct. 4, 1928, p. 505, and the editorial "Fighting Trouble With Trouble" in the same issue. Louisville operators showed ingenuity in making use of the dredge to create artificial turbidity.

The writer knows of several other cases where turbidity was increased for algæ removal. In 1925 I visited the Evanston, Ill., filter plant and the operator told me that they had been adding dry clay to the Lake Michigan water to create an artificial turbidity during August and September to remove algæ. The clay was applied from a dry-feed machine.

During the summer of 1924 the Huntington, W. Va., filtration plant (taking water from the Ohio River) had trouble with synedra clogging the filters. The natural turbidity of the water was about 8 to 10 p.p.m. The algæ were killed by the use of copper sulphate and prechlorination, but they remained in suspension in the coagulating basins and passed on to the filters, making it necessary to wash the filters every few hours. Sufficient clay was added to give the water a turbidity of 50 to 75 p.p.m. The algæ settled out in the coagulating basin and the length of filter runs was increased materially.

LEWIS V. CARPENTER,
Assistant Professor of Sanitary Engineering,
West Virginia University.

Morgantown,
Oct. 13, 1928.

News of the Week

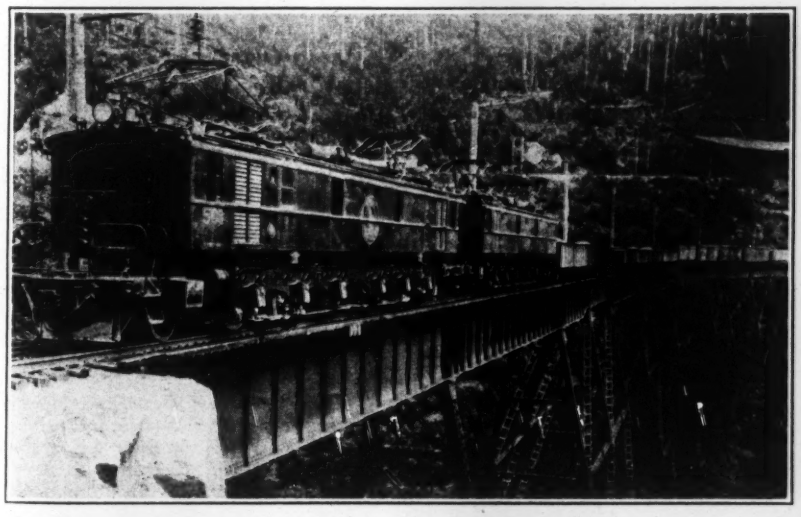
Electrified Cascade Line Opened by Great Northern

Another step in the improvement of the Cascade route of the Great Northern Railway was completed with the opening to traffic Dec. 4 of about 80 miles of electrified line between Wenatchee and Skykomish, Wash. Completion of this project, together with the 8-mile Cascade tunnel, which will be ready for use shortly after the first of the year, and the relocation of 20 miles of east approach to the tunnel, represents an expenditure of $25,000,000.

Until the opening of the tunnel, there is a 4-mile gap between Berne and Cascade tunnel station which is still operated by steam. Completion of the tunnel will permit continuous electric service from Wenatchee to Skykomish.

Transformers and motor generator sets carried on the locomotives make it possible to utilize 11,000-volt alternating current in the overhead wiring. This is stepped down by the transformers to 2,300 volts, and by means of the motor generator set to 1,500 volts direct current for the traction motors. The advantages of this system include low power loss in transmission, flexibility of control in operation and regenerative braking and minimum effect from normal variations in line voltage. Power is obtained from the Puget Sound Power & Light Company system, and it is stated that, through regenerative braking, approximately 35 per cent of the power used to pull a train up the grade is returned to the line after passing the summit.

Two types of locomotives are used, single and double units. The single-unit locomotives, used principally for passenger trains, weigh 518,000 lb. with an overall measurement of 75 ft. Their horsepower, continuous rating, is 3,000; tractive effort, 60,500 lb. at 18.2 miles per hour. For freight service, the double-unit locomotives used weigh 751,000 lb. and have an overall length of 94 ft. 4 in. They have a continuous rating of 88,500 lb. tractive force at 15½ miles an hour and a minimum rating of nearly 7,000 hp.



NEW ELECTRIC LOCOMOTIVES OF THE GREAT NORTHERN RAILWAY

Engineering Supervision of San Gabriel Dam

The $25,000,000 dam in San Gabriel Canyon on which work will soon be started by the Los Angeles County Flood-Control District will be carried on under the general supervision of the district's chief engineer, in addition to whom the county supervisor may retain one or more consulting engineers as the work progresses. For some time the district has retained, in an advisory capacity, the board of three consulting engineers mentioned on p. 734 of *Engineering News-Record*, Nov. 15, 1928, but that reference to the board was in error in so far as it implied that engineering phases of the Flood-Control District's work, including the San Gabriel dam construction, are directed by this board of consultants.

The Los Angeles county supervisors on Nov. 26 adopted a resolution which after referring to the award of the San Gabriel dam contract stated that the remaining projects of the county flood control district no longer justify the cost of the board of consulting engineers, and then resolved to dispense with the services of that board as of Dec. 1, 1928. This board consists of D. C. Henny, J. B. Lippincott and J. W. Reagan.

New York City Contracts for Traffic Survey

Detailed studies of traffic congestion in the five boroughs of New York City, including commuter traffic to New Jersey, will be made for the city by the firm of Day & Zimmermann in an effort to co-ordinate present projects for traffic relief which have hitherto proceeded on the piecemeal plan. The survey will comprise congestion figures, relief plans, and cost estimates, and full utilization will be made of considerable data already gathered by the police department, the department of plant and structures, and a number of private organizations such as the regional planning board of the Sage foundation. Rapid transit problems are excluded from the scope of the survey. The work will not duplicate that of Edward M. Bassett, who has been engaged to undertake a city planning survey.

Mid-Western Flood Causes Damage

Recent high water in tributaries of the Mississippi River in Illinois, Missouri and Kansas caused floods which, though restricted in area, caused considerable damage to property and some loss of life. The situation is summed up in a communication received from Webster T. Bushnell, Quincy, Ill.

Reports published in some metropolitan papers concerning the November floods in the Mississippi River in the vicinity of Quincy, Ill., have created the erroneous impression that great damage was done. There was absolutely no damage done to Quincy property. The only damage occurred in nearby levee districts where levees were broken by flood waters of small tributaries of the Mississippi. None of the Mississippi River levees failed, nor were any of them in real danger. Early Sunday morning, Nov. 18, the waters of Bear Creek, about fifteen miles north of Quincy, broke through the levee on its right bank and poured into Lima Lake Drainage District until the flood subsided somewhat. Very little damage was done to crops, as most of the lands inundated had not yet been drained. Late Sunday night the waters of the Fabius River caused a rupture of the levee on its right bank about seven miles southwest of Quincy and inundated nearly all of the 4,000 acres in the Marion County "Missouri" Levee District. Much of this land bore unharvested corn and rice crops, as well as recently planted wheat. In each of these districts, considerable damage was done to electric motors and other equipment in the pumping plants, and train service on the two lines of the Chicago, Burlington and Quincy Railroad crossing the Marion County district was interrupted for more than 48 hours.

The flood in the North Fabius River at Taylor, Mo., attained a height greater than any heretofore known and seriously threat-

ened the levee on its left bank which protects 14,000 acres of rich lands of the Fabius River Drainage District directly across the Mississippi from Quincy, but caused no crevasse therein and did only slight damage to its levees. No lives were lost on account of flood here. The stage of 17.5 feet in the Mississippi, a record stage for November, stopped all work on the Quincy Memorial bridge and caused some damage to the work and some loss of equipment.

Interruption to railroad service and flooded highways were experienced throughout the flooded district. At Marks, Mo., engineers dynamited a section of levee on the North River, which protects the south end of the drainage district to relieve flood pressure. Part of Kansas City was flooded, and many towns and cities in the states of Illinois, Kansas, Missouri and Kentucky, where the Cumberland River was unusually high.

Contractor Wins Suit Based on Subway Construction

The Supreme Court of New York has awarded a judgment for $482,139 against the city of New York in favor of the Rapid Transit Construction Company as the settlement of a suit based on the construction of a section of the Seventh Avenue subway. The chief items of the award were $288,962 damages for delay by the city in furnishing plans and giving directions, including $95,361 representing increased cost of completing the contract because at a later date it was required to enlarge a passageway between the Pennsylvania Station and the Pennsylvania Hotel, and $115,463 for the actual cost, plus 10 per cent, of constructing a permanent passage between 41st and 42nd Streets. There was also an item of $14,569 for underpinning not included on the engineer's estimate.

Chicago Rejects Bids on Bridge and Meters

For the third time the finance committee of the Chicago city council has refused to approve a contract for 11,400 water meters as recommended by the commissioner of public works. The commissioner favors a particular make and twice recommended the award for this, although the bid was not the lowest. The committee recommended the award to the lowest bidder, but the commissioner rejected all bids and the matter was readvertised. At the recent bidding the lowest bid was for the favored meter, but the committee refused to approve the contract and referred it to a subcommittee for investigation. It was pointed out at the meeting that the city is far behind its program for metering the water supply, as required by the War Department's permit for taking water from the lake. At about the same time the board of local improvements rejected all bids for the substructure of the South Robey St. bridge, which ranged from $549,481 to $725,255. This work will be readvertised.

Wanaque Specifications Permit Alternate Bids With Size Differentials

Lock-Bar, Hammer-Welded and Riveted Sections Included—Completion Required in 21 Months

PROPOSALS for the construction of the long-delayed Wanaque aqueduct of the North Jersey District Water Supply Commission will be received Dec. 20, 1928, at the offices of the commission in Newark, N. J. The specifications, as finally adopted, permit bids on steel pipe of the lock-bar, hammer-welded and riveted (both countersunk and button-headed) type, with a size differential to compensate for differences in carrying capacities. These differentials are as follows:

Type	Diameter (in.)	Plate Length (ft.)	Plate Thickness ((in.)
Lock-bar	74	30	$\frac{7}{16}$, $\frac{1}{2}$
Hammer-weld	74	30	$\frac{7}{16}$, $\frac{1}{2}$
Riveted, countersunk	74	30	$\frac{7}{16}$, $\frac{1}{2}$
Riveted, button-head	75	30	$\frac{7}{16}$, $\frac{1}{2}$, $\frac{5}{8}$
Riveted, countersunk butt girth joints	74	7½	$\frac{7}{16}$, $\frac{1}{2}$, $\frac{5}{8}$
Riveted, countersunk lap girth joints	76	7½	$\frac{7}{16}$, $\frac{1}{2}$, $\frac{5}{8}$
Riveted, button-head lap girth joints	78	7½	$\frac{7}{16}$, $\frac{1}{2}$, $\frac{5}{8}$

The finished pipe sections must withstand a shop test of 175 lb. per sq.in., and the finished line a field test of from 100 to 125 lb. per sq.in. Construction of the line must be completed in 21 months, and there are earlier specified dates for certain sections, with heavy delay penalties scaled up to a maximum of $3,000 per day. All bidders are required to give evidence of qualification for the job, and each must deposit with his bid a certified check for $350,000. It is provided that the name of the pipe manufacturer must be given in the bid, and that he must have had at least five years of experience in the manufacture of the type of pipe used. The successful bidder will be held liable for repairs for one year after completion, the sum of $300,000 being retained to ensure compliance with this specification.

Principal quantities of various classes of work, according to preliminary estimates, are: 164,000 ft. (34,000 tons) of steel pipe, 400,000 cu.yd. earth excavation and 10,000 cu.yd. rock.

Canadian National Assumes Half Interest in Alberta Lines

Half interest in the Edmonton and Dunvegan and Great Waterways Railways, purchased two months ago by the Canadian Pacific Railway from the Alberta Government for approximately $24,000,000, has been assumed by the Canadian National Railway, to take effect upon approval by the Canadian Parliament. It is expected that the newly-acquired lines will be reconstructed to main line standards at once, and that further extensions will be made as justified by colonization.

Brief News

BALTIMORE IS FORBIDDEN to employ laborers in sewer construction more than eight hours a day by an injunction obtained by the International Union of Operating Engineers ordering observance of the city eight-hour law.

COMPLETION of the Coraopolis-Neville Island bridge at Pittsburgh, Pa., was celebrated recently by more than 10,000 persons. Part of the structure consists of two spans of the old Sixth St. bridge which were floated down stream on barges. Two additional spans have since been built to complete the structure.

UNUSUAL SPEED was made in building 70 miles of 33,000-volt transmission line from Lovell to Worland, Wyo. Construction was decided upon Aug. 10. The construction superintendent arrived Aug. 17, material was received and actual work started on Sept. 4, and the line completed Oct. 15. The line carries power from the U. S. Reclamation Service system to a number of communities and rural districts.

FOUNDATION WORK for a new 500-ft. chimney at the Copper Cliff (Ont.) plant of the International Nickel Company has been started. The stack, which will weigh approximately 15,000 tons, will be founded on solid rock.

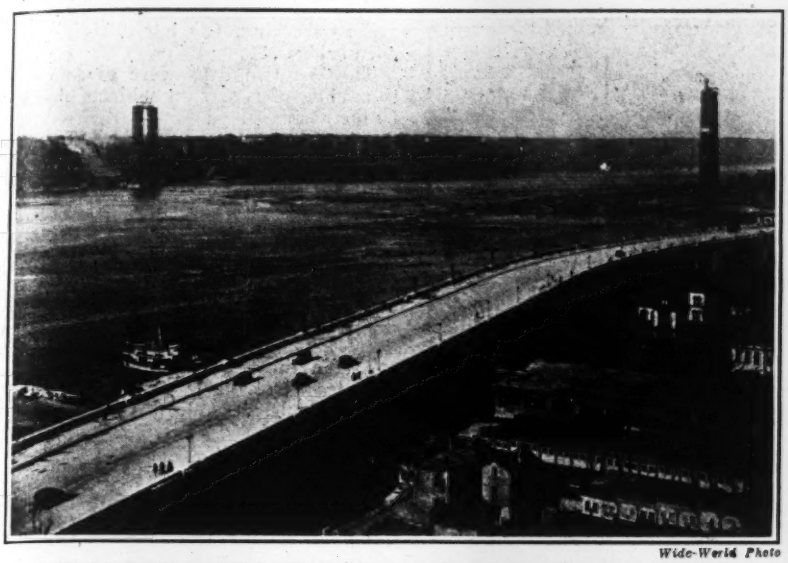
PURDUE UNIVERSITY, Lafayette, Ind., will hold its annual conference on welding Dec. 12-14, 1928. Provision will be made for exhibits and demonstrations.

FIRE IN AN ABANDONED MINE which has been burning for ten months undermined a section of the Pittsburgh-McKeesport boulevard and resulted in the subsidence of about 30 sq.ft. of the pavement.

UNABLE TO OBTAIN a suitable bond, Varnum & Bate, contractors for the new city and county building at Denver, Colo., have been forced to renounce the contract. An attempt was made to transfer it to a new firm, Olson, Simpson & Tamminga, of Denver, but protests from the second lowest bidder on the original award, laid before the city council, were sustained and the action was forbidden. A $50,000 deposit check of Varnum & Bate has been declared forfeit by the city.

A CENTRAL TOWER of 30 stories, 670 ft. in height, will be the feature of a new building being erected in Toronto, Ont., by the T. Eaton Company, Ltd. Construction of the first unit has already begun. The completed building will contain 4,196,158 sq.ft. of floor space.

THE HARAHAN BRIDGE at Memphis, Tenn., was opened to railway trains and bus lines Nov. 15, after being closed since Sept. 17, when it was severely damaged by fire. A full account of the damage was given in *Engineering News-Record*, Sept. 27, 1928, p. 489.



Wide-World Photo

NEW YORK OPENS NEW VIADUCT ON RIVERSIDE DRIVE

A new link in the chain of improvements designed to improve traffic conditions in New York City is formed by this new viaduct, which carries Riverside Drive across the valley from 155th to 161st St., Manhattan. Uptown and downtown traffic formerly had to leave the riverfront at this point and follow a narrow roadway around several short turns and across a number of busy intersections. The new viaduct is of steel frame construction incased in concrete and granite masonry, and carries a 60-ft. roadway with two 20-ft. sidewalks. It was constructed by the P. T. Cox Contracting Company for the city of New York at a cost of $2,360,000. Space beneath the roadway will be utilized by the city for storage and other purposes. The interior wall, shown in the illustration, is plain, as it is expected that buildings will soon rise along the roadway. The river wall has received elaborate architectural treatment, a series of granite base arches extending for the entire quarter of a mile along the riverfront. In the background will be noticed the steelwork on the two piers of the new Hudson River bridge, which have now reached five-sixths of their ultimate height.

Seaboard to Build a New 16-Mile Line in Virginia

Construction of a new 16-mile rail link from Hopewell, Va., to the main line of the Seaboard Railway at or near Norwood, Va., has been authorized by the Interstate Commerce Commission. The new line will be built by the Prince George & Chesterfield Railway, control of which by the Seaboard Airline Railway has been authorized by the commission. The cost of the proposed line is estimated at $987,936. It will be constructed with 85-lb. relay rail, provided a sufficient quantity of such rails can be obtained.

Passaic Valley Sewer Contractor Wins Suit for Claims

Claims and interest totalling $612,566 have been awarded by the Federal Court to Lloyd Makepeace, trustee in bankruptcy for Charles A. Haskin, contractor engaged on the Passaic Valley trunk sewer in 1917. The city of Newark, along with twenty other municipalities, will be forced to pay the award. The claims were based on alleged misrepresentation by the engineers of the Passaic Valley Sewerage Commission on the underground conditions to be encountered within the scope of Haskin's contract. Haskin went into bankruptcy after the seizure of his plant by the commission when he failed to complete his contract.

After the award it was discovered that the interest had been computed at 4½ per cent and immediately counsel for the plaintiff requested the interest be refigured at 6 per cent. This motion is now being argued before Judge Bodine.

Texas Civil Engineers Hold International Meeting

The fall meeting of the Texas Section of the American Society of Civil Engineers, held at Laredo, Tex., Nov. 16 and 17, had an international flavor, as the meeting was attended by 27 engineers from Mexico, including two official delegates from the Mexican National Irrigation Commission and one from the Mexican National Highway Commission. The latter, Salvador Toscono, presented a paper on the progress of highway work in Mexico. Delegates visited the Don Martin irrigation project of the Mexican Government near Camaron, on the Rio Salado, which is being constructed at a cost of more than $25,000,000. W. J. Powell, Dallas, was elected president for the coming year; M. C. Welborn, Fort Worth, first vice-president; E. W. Robinson, San Antonio, second vice-president, and J. T. L. McNew, College Station, secretary-treasurer. The 1929 convention will be held in Dallas in conjunction with the National Association. Considerable discussion was devoted to the proposed Texas licensing act, which will be presented to the next legislature with the approval of the members.

Van Norman New Los Angeles Water Department Head

On Nov. 27 H. A. Van Norman was appointed chief engineer and general manager of the Los Angeles Bureau of Water Works and Supply, effective Dec. 1, succeeding William Mulholland, whose resignation was announced in *Engineering News-Record*, Nov. 22, 1928, p. 785. Mr. Van Norman is a native of Texas, who went to Los Angeles in 1902 and since then has been engaged in engineering and construction work in southern California. For five years he was with the Los Angeles and Pacific Electric railways and for one year with the Los Angeles Gas & Electric Company. During the past 21 years he has served the Bureau of Water Works and Supply in various capacities, this period covering the building of the Owens Valley aqueduct, on which he was construction engineer, and the planning of the proposed Colorado River aqueduct, on which attention has centered of late. In recent years he has held the position of assistant chief engineer and general manager of the water bureau under Mr. Mulholland. The only interruption in his long service with the water department was a leave of absence of less than two years granted to allow him to take charge of construction of a $12,000,000 trunk sewer project for the Los Angeles city engineering department.

Bridgeport Engineers Compare Welding With Riveting

At a joint meeting of the Bridgeport Section, A.S.M.E., and the Engineers Club of Bridgeport, Conn., recently, both riveting and welding were openly discussed. Chauncey Hanna, president, Hanna Engineering Works, Chicago, Ill., presented a film entitled "This Is the Age of Riveted Steel," showing methods of making rivets, the application of rivets in modern steel fabrication and the use of automatic riveting machinery that entirely eliminates the human element. E. Ewartz, for many years manager of the Moore plant of the Bethlehem Steel Company, stated that this human element exists in both riveting and welding, but it is his belief that the importance of the human element in welding is being overemphasized and that good welding rests more on proper design, materials, welding wire and welding machinery. Slides shown by Mr. Ewartz emphasized the simplicity of the welded structure and gave results of comparative tests on a 6-in. I-beam fastened respectively by welding and riveting

to uprights at each end, in which the riveted structure failed at a loading of 60 tons with a deflection of 1 in., while the welded structure failed at a loading of 90 tons with a deflection of 3 in. Mr. Ewartz stated that sixteen of the largest shipbuilders in the United States used last year more than 24,000,000 cu.ft. of acetylene for cutting and welding and that one manufacturer, the Page Steel & Wire Company, sold several thousand tons of welding wire during 1927.

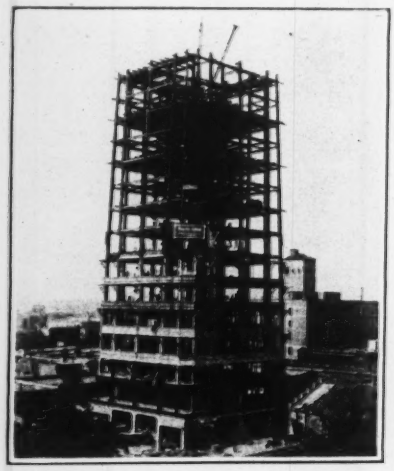
Dr. William Spraragen, secretary, division of engineering, National Research Council, told of the important research work being done by the welding industry. All three of the speakers admitted that both welding and riveting had their own field of application and that although the fields overlapped in many cases, there was plenty of business for both. In many jobs whether riveting or welding is to be used will be simply a matter of economy.

Four New Incinerators to Be Built for New York

Dumping of New York City's garbage at sea is expected to be completely eliminated with the completion of four new garbage incinerators recently approved by the Board of Estimate at a cost of $5,000,000. These new plants, together with five already in operation and three now under construction, are expected to care for all refuse of the city, as well as to reduce the cost of garbage disposal. Considerable complaint has been caused by the present practice of dumping refuse at sea, which it is claimed has resulted in rendering several beaches unfit for bathing.

Engineering Council Endorses Prosperity Reserve Principle

Approval of the principle of providing for "the expenditure of federal funds on public works already authorized to increase employment in times of extraordinary depression of private industry, provided such expenditure can be carried through without any increase of taxation" has been given by the American Engineering Council through its administrative board. The Council specifically endorses legislation proposed at the last session of Congress by Senator Wesley L. Jones of Washington, which embodied this principle. A bill to place a similar plan into effect in Massachusetts, creating a reserve construction fund of $3,000,000, has already been introduced into the state senate. Under its provisions, a state reserve fund would be established and cities and towns would be authorized to appropriate and borrow money for employing citizens on public works at times of business depression. The fund would be controlled by the state treasurer and would be set up through appropriations by the legislature. The Governor and Council would be authorized to expend the money when they deemed it advisable.



MINNEAPOLIS TOWER BUILDING TAKING FORM

Construction is well along on the unusual structure being erected in Minneapolis, Minn., by the W. B. Foshay Company, and known as the Foshay Tower. Its ultimate height will be 32 stories, or 450 ft. The tower section is 81x87 ft. at the base and will be 59x65 ft. at the top. A two-story building will surround three sides of the tower and will cover an area of one-half a city block. Although the entrance will be through the low building, the tower itself is a separate structure on its own foundation 69 ft. deep. There will be five stories below the street level, two of which will be used for a garage with a capacity of 265 cars. The superstructure will be finished in Bedford sandstone and will be ready for occupancy about May 1, 1929. The estimated cost is $2,100,000. Magney & Tusler, Inc. of, Minneapolis, is the architect; Oscar Daniels Company, Chicago, is the contractor.

International Congress of Bridge and Structural Engineering

The second international congress of bridge and structural engineering was held Sept. 24-27 in Vienna, with an attendance of 650, eight of whom were from the United States. The sessions of the first two days were occupied with discussions of fundamental problems, as follows:

General problems of steel and reinforced-concrete construction, including (1) architecture of steel and reinforced-concrete bridges, (2) effect of impact of moving loads on bridges, (3) high-grade (carbon) steel structures and reinforced-concrete construction, (4) results of experiments to ascertain the value of stress measurements in finished buildings made of steel, concrete and reinforced concrete.

Problems of steel construction, including (1) safety and allowable stresses, (2) buckling of rods under axial and eccentric forces, (3) stresses in rivet work.

Problems of reinforced-concrete construction, including (1) long span arch bridges, (2) shearing resistance of concrete, (3) high-grade concrete and its field control, (4) safety of concrete against cracking, (5) lateral rigidity of open bridges.

The last two days were given over to reading of papers on subjects chosen by the members.

The first congress was held in Zurich, Switzerland, in September, 1926, and the third will be held in 1931 in Paris. Dr. F. Bleich, Vienna, Austria, was secretary of the congress.

New Musconetcong Tunnel Opened to Traffic

Traffic through the new Musconetcong tunnel of the Lehigh Valley R.R. near Pattenburg, N. J., was inaugurated Nov. 26. The double-track tunnel is 4,840 ft. long, and was built to relieve a single-track tunnel nearby which was completed in 1875, and is still in use. The project was described in *Engineering News-Record*, Dec. 22 and 29, 1927, pp. 988 and 1036.

E. A. Sperry Heads Mechanical Engineering Society

The election of Elmer Ambrose Sperry, scientist and inventor, as president of the American Society of Mechanical Engineers was recently announced as the result of a letter ballot in which nearly 20,000 members participated. Mr. Sperry is 68 years old, and is best known for his development of the gyro-compass and the application of the gyroscope to the stabilization of ships and air machines. He developed, before he was 20 years old, an arc light upon which is based many of the airplane beacons now in use. He has also produced electrical mining machinery, street railway cars, electrical automobiles, and has contributed to the science of electrochemistry and aerodynamics.

Three vice-presidents were elected by the Society, among them Robert L. Daugherty, Professor of Mechanical and Hydraulic Engineering in the California Institute of Technology.

Cross-Connection Report to Be Discussed by N.E.W.W.A.

Further discussion of the report of the committee on cross-connections of the New England Water Works Association will take place at the next regular meeting to be held in Boston, Mass., Dec. 12. The report was first presented to the society at Boston, March 14, 1928, and was printed in the June, 1928, *Proceedings* of the association and also in *Engineering News-Record*, March 22, 1928, p. 488. It advocates the ultimate elimination of all cross-connections and, pending this, the use of double check valves adequately maintained to safeguard the health of the community. The meeting will also hear a paper by Charles E. Kendall, water commissioner of Winchester, Mass., entitled "Reforestation on the Watersheds of the Winchester Water Supply."

Board Reports on Boulder Dam

The report of the Board of Engineers and Geologists to investigate the feasibility of the Boulder Dam project was transmitted to the President and Congress Dec. 3. It endorses the engineering phases and (with a qualification) also the economic phases of the subject.

Black Canyon is found to afford a better dam site than Boulder Canyon, although a 550-ft. dam to store 26,000,000 acre-ft. is feasible at both locations. A gravity dam limited to 30 tons per sq.ft. in place of the 40-ton pressure previously contemplated is recommended. To safeguard construction more fully it is proposed that the diversion tunnels be made 200,000 sec.-ft. in capacity instead of 100,000.

Construction, maintenance and operation of the All-American canal through the sand dune region lying between the Colorado River and Imperial Valley is found to be feasible.

A lower figure is set for river flow than has been commonly assumed heretofore. The original undepleted flow at Black Canyon is set at 15,000,000 acre-ft. per year and the present or depleted average flow at 12,250,000. The danger of contamination by salt beds in the Virgin River Valley is held not important, nor is the matter of silt pick-up below the dam considered serious. Continuous power development of 550,000 hp. is found to be practicable under present irrigation conditions, but this may reduce nearly one-half in thirty or forty years.

The cost of the project is set at $165,000,000, including interest during construction; $11,000,000 would be added if the canal is extended to the Coachella Valley. Of the first figure stated, $38,500,000 represents the cost of the canal and $38,200,000 the cost of the power development for one million installed horsepower. The demand for power in California is held to be sufficient to absorb the output. At the present very low costs of steam power, the cost of the project could not be amortized within a 50-year period if the All-American canal were charged to power. If the canal and part of the flood-protection cost are paid for separately, the remaining cost can be amortized by power income.

The report is signed by the full Board: Major-Gen. William L. Sibert, chairman; Charles P. Berkey and Warren J. Mead, geologists; Daniel W. Mead and Robert Ridgway, engineers.

Illinois Society Plans Courses in Engineering

A new activity just started by the Illinois Society of Engineers is the handling of engineering extension work by a series of short courses, such as are conducted by some technical colleges. As a first step, two-day short courses in the design and control of concrete mixtures are to be held in several cities during November, December and January. The tentative program, which will be the same in each city, provides three subjects for each day, as follows: "Fundamental Properties of Concrete," by C. C. Wiley, University of Illinois; "Design of Concrete Mixtures by the Water-Cement Ratio Trial Method," by Edward E. Bauer, University of Illinois; "Bulking of Aggregates," by R. S. Phillips, Portland Cement Association; "Factors Affecting the Quality of Concrete," by C. C. Wiley; "Field Control Methods," by R. S. Phillips, and "High Early-Strength Concrete," by Edward E. Bauer. Plans for this new field of the society's work have been developed by the president, J. A. Moore, of Chicago, and the secretary, Prof. H. E. Babbitt, of the University of Illinois, Urbana, Ill.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

President's Message Treats of Boulder Dam, Muscle Shoals, and Latin-American Road Aid

THAT the President regards the report of the Boulder Dam Engineering Board as sufficiently favorable to warrant enactment of legislation at this session of Congress is indicated in his message. His comment on the Colorado River situation was, in part, as follows:

For several years the Congress has considered the erection of a dam on the Colorado River for flood control, irrigation, and domestic water purposes, all of which may properly be considered as government functions. There would be an incidental creation of water power which could be used for generating electricity. As private enterprise can very well fill this field, there is no need for the government to go into it.

The Congress will have before it the detailed report of a special board appointed to consider the engineering and economic feasibility of this project. From the short summary which I have seen of it, I judge they consider the engineering problems can be met at somewhat increased cost over previous estimates. They prefer the Black Canyon site. On the economic features they are not so clear and appear to base their conclusions on many conditions which can not be established with certainty. So far as I can judge, however, their conclusions appear sufficiently favorable.

Muscle Shoals

In his message to Congress the President reiterated his opposition to the entry of the government into the retail field of power distribution and sale of fertilizers. In referring to Muscle Shoals he said:

The development of other methods of producing nitrates will probably render this plant less important for that purpose than formerly. By dividing the property into its two component parts of power and nitrate plants it would be possible to dispose of the power, reserving the right to any concern that wished to make nitrates to use any power that might be needed for that purpose. Such a disposition of the power plant can be made that will return in rental about $2,000,000 per year. If the Congress would grant the Secretary of War authority to lease the nitrate plant on such terms as would insure the largest production of nitrates, the entire property could begin to function.

I wish to avoid building another dam at public expense. Future operators should provide for that themselves. But if they were to be required to repay the cost of such dam with the prevailing commercial rates for interest, this difficulty will be considerably lessened. Nor do I think this property should be made a vehicle for putting the United States Government indiscriminately into the private and retail field of power distribution and nitrate sales.

Latin-American Highways

Action by the United States to stimulate highway construction in Latin America is recommended by President Coolidge in his message to Congress. He advocates the detail of engineers from the Bureau of Roads to act as advisers to the governments of the southern republics in carrying forward their road-building programs.

It is believed that the emphasis given inter-American highways by the President's message will do much to expedite the consideration of the pending legislation intended to put such a plan into effect. The feature of the bill providing that the highway advisers be drawn from the ranks of government engineers is being strongly opposed on the ground that this would discriminate against engineers in private practice who readily could be retained for such service.

Smelter Fumes Cause International Problem

Members of the International Joint Commission are reviewing the testimony recently taken in the investigation of alleged damage, in the State of Washington, caused by fumes from the smelter of the Consolidated Mining & Smelting Company, at Trail, B. C. Statements before the commission as to the extent of the damage caused by the fumes vary widely. Representatives of the smelting company contend that damage to crops did not exceed $3,000 in 1926 and 1927 and that actual losses in 1928 did not exceed $600. On the other hand, representatives of the farmers and of the Washington county contiguous to the British Columbia area, in which the smelter is situated, contend that $600,000 or $700,000 is a more correct indication of the "economic importance of the question involved."

The problem presented to the International Joint Commission is a particularly difficult one, in that the laws of the State of Washington are such as to preclude any purchase of lands or easements by the nationals of other countries. It also is recognized that a decision in this case will constitute a precedent of far-reaching effect. Whatever is done in this case will have an important hearing on the erection of furnace smelters in a mineralized area certain to grow in importance. It has been pointed out to the commission that even now consideration is being given to the erection of a smelter on the American side of the boundary in the Pend Oreille.

Engineering Societies

CALENDAR

Annual Meetings

AMERICAN ROAD BUILDERS' ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 14-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; annual meeting, New York, N. Y., Jan. 16-18.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; annual convention, Detroit, Mich., Feb. 12-14.

THE AMERICAN RAILWAY ENGINEERING ASSOCIATION is to be represented at the World Engineering Congress to be held in Japan in October, 1929, by E. H. Fritch, the secretary of the association. This decision was made at a meeting of the Board of Direction held in New York on Nov. 20.

THE MISSOURI WATER AND SEWERAGE CONFERENCE is the new name of the former Missouri Conference on Water Purification, this change having been made to indicate the present scope of interest, including municipal sewerage as well as water systems. Another change in the constitution provides for affiliation with the Federation of Sewage Works Associations. At the three-day meeting held at Hannibal, Mo., Nov. 15-17, about 75 members and guests were present and there was active discussion of the several papers presented. The officers elected for 1928-29 include: Chairman, C. E. Heflin, water commissioner, Cameron, Mo.; vice-chairman, S. J. Duncan, superintendent of water-works, Moberly, Mo.; secretary and treasurer, H. D. Peters, assistant engineer, state board of health, Jefferson City, Mo.

THE PACIFIC NORTHWEST SECTION, American Water Works Association, held its meeting in Seattle Nov. 16-17. The guests were taken over the Seattle water-works system as guests of the Seattle Water Department. Homer O. Blair, of Tacoma, consulting engineer, gave an address on "Underground Water Resources in the Vicinity of Tacoma."

THE TRI-STATE TECHNICAL SOCIETY was organized at Amarillo, Tex., at a meeting Nov. 7. F. D. Burr was elected president and George Broome, secretary-treasurer. The society will attempt to enroll 300 or more members from the engineering profession in the Texas Panhandle, Western Oklahoma, and Eastern New Mexico.

THE MISSISSIPPI VALLEY ASSOCIATION, at its annual convention in St. Louis, November 26 and 27, placed the Association on record as favoring standardization of locks, terminals and floating equipment, and a uniform channel of nine ft. minimum depth on all trunk routes, which were specified as the Mississippi, Missouri and Ohio Rivers and the Illinois waterway and intra-coastal canal in Louisiana and Texas. The right to divert water from Lake Michigan for the Illinois waterway was upheld, and Denison Barge Line bill praised. Congress was requested to appropriate $10,000,000 for added equipments and barges for the Inland Waterways Corporation. The association also urged all river cities to construct dock and terminal equipment immediately. Officers elected were: President, William R. Dawes, Chicago; vice-president, T. F. Cunningham, New Orleans; secretary, Lachlan MacLeay, St. Louis.

THE SEATTLE CHAPTER, Western Public Works Contractors' Association, met in that city Nov. 16-17 and elected the following officers: President, H. L. Goetz; vice-president, F. J. McHugh; secretary, A. L. Crisman; treasurer, C. L. Creelman.

THE OHIO CONFERENCE ON SEWAGE TREATMENT has elected the following officers for 1929: C. C. Hommon, Canton, chairman; Floyd G. Browne, Marion, secretary-treasurer.

THE OHIO CONFERENCE ON WATER PURIFICATION has elected C. T. Kaiser, Newark, chairman, and James M. Montgomery, Piqua, secretary-treasurer for next year.

Personal Notes

ARTHUR V. RUGGLES, formerly chief civil engineer and commissioner of water of the Cleveland Water Department and recently on engineering work for the Community Water Service Company of New York, is now located in the office of the American Water Works Association in the Engineering Societies Building, New York City, and devotes half his time to his duties as assistant to the secretary, especially in connection with the work of research and collection of information on water-works practice for the association's committee on that subject. The other half of his time Mr. Ruggles gives to the sectional committee on specifications for cast-iron pipe and special castings.

ERNEST H. WILCOX, for the past five years chief engineer of the Pan American Petroleum Company, has opened an office as consulting engineer, with a staff of technical specialists, in the Petroleum Securities Building, Los Angeles, Calif.

HAROLD M. GOULD, transportation engineer for Dodge Bros., Inc., has been retained as traffic engineer to the police department of Detroit, Mich. The position was restored by order of council. Last year it was eliminated by cutting it out of the 1928 budget. Mr. Gould made a traffic survey for Detroit last year.

OSCAR A. PIPER has been appointed assistant city engineer of Seattle, taking office Dec. 1. Mr. Piper received highest grades at a recent civil service examination. He is a graduate of the civil engineering school at the University of Washington and as government engineer supervised construction at Fort Flagler and Casey on Puget Sound, and in Alaska. He also made the survey of the roadway up Mount Rainier. For several years he had charge of designing and construction of city improvement under the city engineering department and recently has been principal assistant to the state engineer.

WARREN H. MCBRYDE, consulting engineer, of San Francisco, will sail from that port on Jan. 4 to study harbor development, inland waterways and railways and industrial engineering progress in the Orient and Europe.

A. K. HAXSTUN and C. L. TINDALL sailed on Nov. 17 to engage in the road-building program of Costa Rica. Both have taken an active part in highway construction for the last decade, especially in the heavy roadbuilding program of North Carolina and later in the Republic of Mexico.

A. G. BISSELL, welding engineer for the Westinghouse Electric & Manufacturing Company, has resigned and plans to enter the industrial field as an independent consultant in arc-welding engineering on the Pacific Coast.

LOUIS A. HEQUIMBOURG, formerly engaged in development work at Oswego, N. Y., has opened an office as a consulting engineer in that city.

Obituary

ALMOS DAVIDSON NEELD, consulting engineer, died Nov. 28th at his home near Pittsburgh, Pa. Although connected with a number of notable engineering works, his best known project was the new Liberty tunnel in Pittsburgh, the first long highway tunnel ever designed to accommodate modern automobile traffic. Mr. Neeld was born in 1858 and graduated from the Western University of Pennsylvania (now University of Pittsburgh) at the age of seventeen. He was engineer in charge of new construction for the Pittsburgh & Western railroad until 1885, leaving to become engineer of construction and maintenance of way of the Pittsburgh & Lake Erie railroad until 1888. He then engaged in the contracting business in Pittsburgh and Washington, D. C., building, among other structures, the Bennings bridge, the Rock Creek bridge and the Klingle road bridges and the foundation for the post office in Washington. Since 1899 Mr. Neeld has been a consulting engineer in Pittsburgh. He was the compiler of a complete table of safe loads and stresses for plate girder bridges and steel roof trusses and, at the time of his death, was working on a new and faster method of designing re-inforced concrete construction. This work is well along toward completion and will, through his successors, be brought to a conclusion. He was a member of the American Society of Civil Engineers.

Construction Equipment and Materials

Johns-Manville Acquires Celite

Announcement has been made by the Johns-Manville Corporation of the acquisition of the assets and the entire line of products of the Celite Products Company, including the latter company's holdings of one of the largest known sources of diatomaceous earth, located in California. Products of the Celite company include, among others, concrete admixtures, filtration materials and high-temperature insulation. The Celite business will be developed and amplified by Johns-Manville.

To Study Calcium Chloride Action at Ohio State

Calcium chloride as a curing agent for concrete will be studied at Ohio State University by a graduate fellow, holder of the fellowship established by the Calcium Chloride Publicity Committee. This research will be directed by Prof. R. C. Sloane, department of civil engineering, and Dr. W. J. McCaughey, department of mineralogy, and will include, in addition to physical tests, a study of the crystals formed in concrete during the curing process. The committee will be represented by H. F. Clemmer.

This is the fourth fellowship maintained this year by industries co-operating with the Engineering Experiment Station of the Ohio State University. The others were established by the Electrical Porcelain Manufacturers' Association, the Aluminum Company of America and the American Institute of Steel Construction.

Trade Practices Discussed at Washington Conference

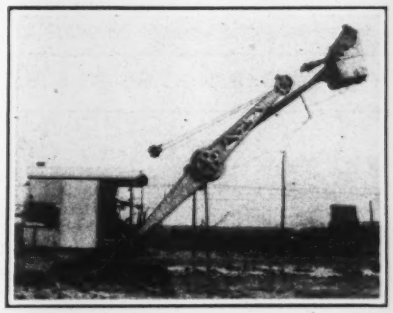
Unfair and uneconomic practices in distribution and the activity of trade associations were among the subjects discussed at a conference of representatives of machinery and equipment associations held under the auspices of the U. S. Chamber of Commerce at Washington, D. C., Nov. 8. Representatives were present from sixteen organizations, among these the American Road Builders' Association, the Associated General Contractors, the Compressed Air Society and the National Crushed Stone Association. A brief history of the Federal Trade Commission and its procedure was given by Henry P. Fowler, assistant manager, research department, U. S. Chamber of Commerce. W. H. Rastall, chief of the industrial machinery division, Department of Commerce, compared the machinery industries of this country with that of Germany, concluding that with one-half as many factories and 80 per cent as many workmen the United States produces more than three times the volume of machinery.

In order that subjects to be discussed at the next conference, to be held Feb. 14, 1929, shall be of greatest interest to those who will attend, each association participating is requested to forward to the trade association department of the U. S. Chamber of Commerce a statement indicating its opinion as to the relative importance of the various subjects listed for discussion. These include unfair competitive practices, uneconomic practices, the tariff, census schedules and classifications, depreciation, obsolescence, uniform cost accounting, statistics, credits and sales terms.

New Developments

Two Companies Unite in Design of ½-Yd. Shovel Crane

Collaboration by two well-known equipment companies has resulted in the production of a new ½-yd. convertible crawler crane and shovel unit, with interchangeable attachment for clamshell and dragline booms, shipper shaft and ditcher-type shovels, back digger and skimmer scoop. The machine, known



as the Universal 35, is manufactured under patent rights granted by the Thew Shovel Company to the Universal Crane Company (both of Lorain, Ohio), and combines the Universal superstructure with the Thew center-drive crawler. The crawler consists of an all-steel box-section casting resting on four large axles, each capable of supporting the entire weight of the machine.

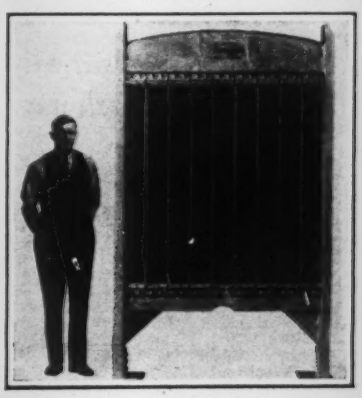
Four large rollers on each side are mounted on the axle, the center two being the drivers. These obtain their power from a common driving pinion gear on the center-drive principle. Jaw clutches sliding on square axle shafts engage the crawler for steering or travel. Two travel speeds are available: 0.4 m.p.h. in low gear and 2 m.p.h. in high gear. The machine will climb a 35 per cent grade in low gear and a 12 per cent grade in high gear. With the clutches in neutral it can be towed by a 3½-ton motor truck.

On the shovel unit the shipper shaft is placed in the center section instead of on the top of the boom, the usual practice. This is the first ½-yd. shovel to be built on the principle of the center drive, such as is used in the larger Lorain model. The boom is 18 ft. long, of plate girder construction to the shipper shaft and lattice construction from there to the head. An all-steel welded rectangular section 14 ft. 4 in. long is used for the dipper stick. This rides between two large, circular bearings which furnish a machined track for a six-wheel, rollet type trolley replacing the usual yoke. The crowding mechanism is of simple design, consisting of a shipper shaft running in bronze bearings, a pinion and a cable winding drum.

Standard practice of the Universal Crane Company is followed in the superstructure. All the machinery parts are grouped well back of the center pin, thus acting as a counterweight and enabling the outfit to handle the maximum load with the minimum dead weight. As a crane the outfit has a capacity of 7 tons at a 10-ft. radius, handling a ½-yd. clamshell or dragline bucket or a 1-yd. backfiller board. The operator's seat is located at the extreme front of the turntable with an unobstructed view of the work. The hoist shaft is equipped with two drums, separately driven, which are grooved to prolong cable life. All controls are conveniently grouped about the operator's seat. A foot pedal has replaced one hand lever, so that three hand levers and two foot pedals control all major operations. As on previous models, the new model 35 is adaptable to several mountings, in addition to the crawler. These include a 5-ton or heavier motor truck, heavy-duty trailer, railroad flat car and others. The machines will be marketed through the sales organization of the Universal Crane Company.

Heavy-Duty Radiator Designed for Severe Service

Built especially for contractors and for use in oil field work, where severe operating conditions render the automotive type of core radiator impracticable, this new type of heavy-duty



industrial radiator is being manufactured by the Young Radiator Company, Racine, Wis., in sizes suitable for engines from 200 to 300 hp. The radiators, which are furnished either with or without fan equipment, are procurable in several sizes, depending upon the horsepower it is required to cool and the conditions of operation.

Business Notes

INDEPENDENT PNEUMATIC TOOL COMPANY, Chicago, Ill., will commence construction shortly of an addition to its Aurora, Ill., factory, which will consist of a modern concrete building containing 36,000 sq.ft.

WAGNER ELECTRIC COMPANY, St. Louis, Mo., has transferred H. N. Felton, formerly branch manager of the Milwaukee office, to the post of branch manager of the New York office. He will be succeeded in Milwaukee by F. T. Coup, who has been in charge of the Cincinnati office since 1921.

J. B. FRENCH COMPANY, Chicago, Ill., has appointed as vice-president Vernon C. Ward, formerly contracting manager of the Chicago office of the American Bridge Company and recently manager of sales of the steel construction department, Jones & Laughlin Steel Corporation.

W. A. RIDDELL COMPANY, Bucyrus, Ohio, announces that the newly established branch at North Little Rock, Ark., is under the direction of O. E. Taplev, formerly with the Arkansas State Highway Department.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburgh, Pa., has contracted with the Commercial Investment Trust Corporation, New York City, to take over the financing service formerly operated by the Westinghouse Acceptance Corporation, a subsidiary of the main Westinghouse company.

ORELITE COMPANY, INC., has elected the following new officers: S. Janovici, president and treasurer; J. Gilbert Mason, Jr., vice-president and secretary; A. Janovici, assistant secretary; M. J. Kaufman, assistant treasurer.

Manufacturers and Trade Associations

CALENDAR

ANNUAL MEETINGS

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 9-11, 1929.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 14-18, 1929.

NATIONAL CRUSHED STONE ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 21-24, 1929.

New Publications

Recording Instruments — BRISTOL COMPANY, Waterbury, Conn., has issued a new catalog, No. 1900, describing its long-distance electric transmitting and recording systems.

Concrete Admixtures—CELITE PRODUCTS COMPANY, Los Angeles, Calif., discusses the workability of concrete, and how it can be controlled, in a 7-p. illustrated bulletin, No. 340.

Arc Welding — LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has issued a supplement to its text book "Arc Welding—The New Age in Iron and Steel." This is a 32-p. book entitled "How to Begin Application of Arc Welding in Production Manufacturing," and is devoted to the redesigning of machinery and the principles involved therein, for the purpose of using arc welding and structural steel shapes in place of cast iron.

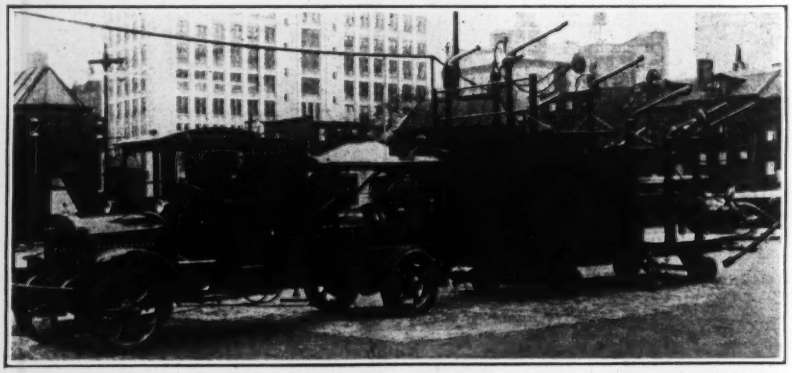
Excavating Machinery — THEW SHOVEL COMPANY, Lorain, Ohio, has issued a handbook on the operation, care, adjustment, and application of power shovels and excavating machines. This is published in loose-leaf form, so that it may be kept up to date by future additions. It is divided into three sections, one covering operation, the second, care and adjustment, and the third, general information, data and tables pertaining to excavation work. The first gives detailed instructions for shovel, clamshell, dragline and backdigger work, including cable reeving, digging methods, and ways of unloading and loading machines for transportation. It also includes range diagrams covering all models of Lorain machines. The second section, on care and adjustment, furnishes the operator with the proper method of caring for his machine by means of diagrams and text. The third section is the real handbook section of the book, as it contains material weight tables, equivalent and conversion tables and tables of ditch and spoil bank dimensions, blasting data and crusher sizes. Information on costs is also given. The book is printed on heavy, durable bond paper and is bound in a flexible cover. Blank pages for notes are bound in between the sections. It is distributed by the Thew Shovel Company at a nominal cost.

Surveying and Drafting Instruments—A. S. ALOE COMPANY, St. Louis, Mo., has issued a new edition of its catalog of surveying equipment and drafting room supplies for engineers and draftsmen. This contains 135 pp., is well illustrated and forms a complete guide to present engineering equipment.

Portable Electric Hoist — SULLIVAN MACHINERY COMPANY, Chicago, Ill., has issued a 32-p. illustrated book describing the applications of portable electric hoists in tunneling, dragline work, mining and car shifting. The bulletin, which is known as No. 76-J, includes descriptions of hoists from 10 to 35 hp. in both single- and double-drum patterns.

Snow Removal Equipment—ALLIS-CHALMERS MANUFACTURING COMPANY, Monarch Tractor Division, Milwaukee, Wis., has issued an illustrated book, "The Removal of Snow," which discusses the use of tractor-drawn equipment in winter highway clearing. Specifications of Monarch tractors are included.

CLEANING THE WALLS OF THE HOLLAND TUNNEL



Cleaning of the tile and sheet-metal walls of the Holland vehicular tunnel connecting New York City with New Jersey was decided upon as the result of the gradual increase in a black carbon smudge left as a residue by the carbon monoxide gas. The machine pictured above was devised by the tunnel engineers in collaboration with Howald, Klingelfuss & Kenny, Brooklyn, N. Y., for this purpose. It consists of a standard 2½-ton Mack truck on which is mounted a 200-ft. Ingersoll-Rand compressor. To this is coupled a trailer which carries two 700-gal. tanks, one for water and the other for a solution of trisodium phosphate, which, it has been found, will loosen the dirt sufficiently to permit it to be flushed away. Along the sides of the trailer are a number of nozzles supported by short crane arms balanced by counterweights. These nozzles discharge in the center of 12-in. soft horse-hair brushes operated by workmen standing on the side of the trailer. Each man has a section of wall 2 ft. high to clean as the machine passes through the tunnel at a rate of approximately 0.7 m.p.h.

The Business Side of Construction

Prices of Construction Materials Continue Upward Trend

Probability of early enactment of tariff legislation against imported building materials is perhaps the chief factor in the present outlook for continued upward movement of prices in the construction group. This upward trend has continued since January without a single recession of major importance.

In this month's price changes there are more than twice as many advances as declines, compared with the Nov. 1 levels. Among the principal materials there is a decided tendency toward higher prices for the following: Cast-iron pipe, gravel, crushed stone, lime, linseed oil, glass, belting leather, steel lumber, copper.

A weaker market prevails in such materials as brick, glass, tile, red and white lead, and expanded metal lath. The structural steel market bids fair to close the year with prices approximately 10c. per 100 lb. above those obtaining at the start. Large mill lots of shapes are selling now at $1.90 per 100 lb., f.o.b., Pittsburgh mill. This price has held since Oct. 1. Unusual steel demand is reflected in the October ingot output of 4,647,891 tons, the highest for any single month on record. This performance is backed up by a commensurate increase in demand as reflected by orders on books, which show an increase of 12 per cent compared with those of a year ago.

Quotations on heavy timbers moved upward approximately $2 per thousand feet at New York during the last month. This is in keeping with the general upward trend throughout the entire country, which has characterized lumber prices since last April. Reserve stocks of seasoned lumber at mills and in dealers' yards are at lowest levels touched in years. This is particularly true of the softwoods, production of which is now running at about 321,000,000 ft. per week. That the usual seasonal decline in lumber demand has already set in is indicated by the current weekly rate of shipment, which averaged about 14 per cent under the cut.

The outlook in lime is for an upward turn in prices. Southern lime is 15c. a barrel higher than a month ago, on common lump. Prices of crushed stone and gravel are rising sharply in the Middle West owing to difficulty in handling, caused by freezing weather.

The principal materials in which there is price weakness, compared with November levels, are as follows:

Brick stocks held in reserve at plants throughout the country are the heaviest on record. Prices, however, have shown no widespread tendency to decline, despite a seasonal drop in buying. The New York wholesale price continues steady at $14 per thousand, alongside dock, for first-class brick. Orders are being taken at the rate of 213,000,000 per month as compared with shipments of approximately 167,000,000.

The Birmingham base on cast-iron pipe is up $2 per ton, making a total advance of $5 since July 1, 1928. During this period, pig iron has steadily advanced in price, following a prolonged period of decline.

Close competition among dealers in hollow tile has resulted in scattered price declines at various points throughout the country. Quotations that average a fraction of a cent below November prices are reported in Cleveland, Dallas, Los Angeles, Minneapolis and New York.

Indication of a possible reduction in prices of red and white lead is seen in the announcement by leading manufacturers that jobbers and dealers will be protected against loss in case of price decline, on unsold stocks purchased on or after Nov. 19, 1928.

Expanded metal lath prices are nominal as quoted, owing to the severity of persistent price cutting among dealers.

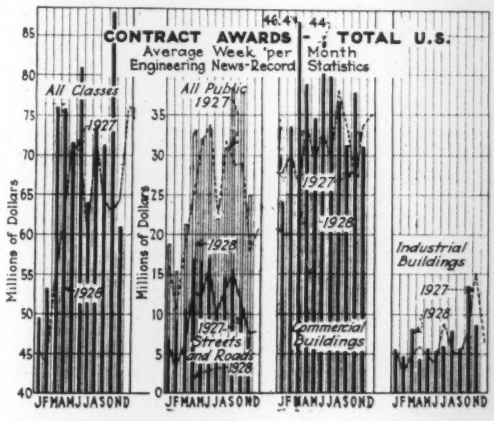
The price position of cement is greatly strengthened by the fact that average monthly production, which runs at about 17,533,000 bbl., is keeping at least 2,000,000 bbl. a month under the rate of shipments. This insures a continuation of the gradual seasonal decrease in reserve mill stocks, which has been recorded by the Bureau of Mines since April, 1928.

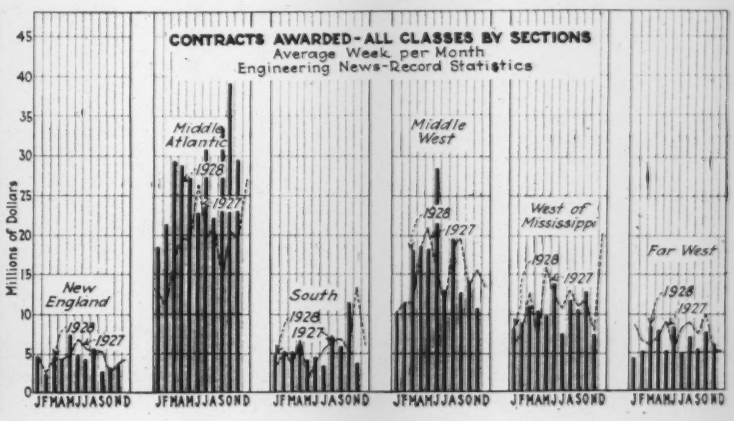
VALUE OF CONTRACTS BY SECTIONS IN THE UNITED STATES AND TOTAL FOR CANADA, NOVEMBER, 1928

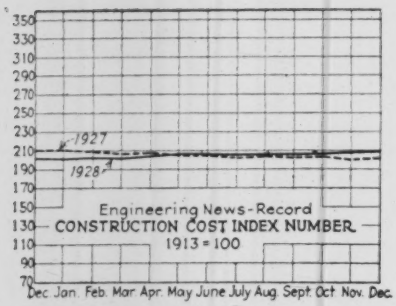
Thousands of dollars (-000 omitted)

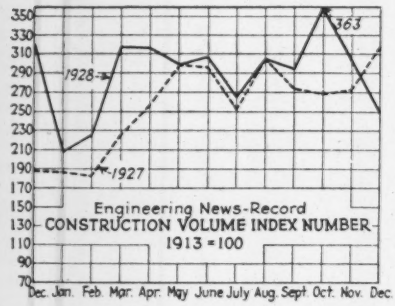
	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Dec. 1, 1928 U. S.	Canada
Water-works	$315	$2,153	$147	$942	$1,966	$245	$5,768	**$91,473**	$51
Sewers	124	3,653	84	3,256	365	765	8,247	**94,636**	399
Bridges	75	6,540	1,553	495	2,232	6,220	17,115	**119,552**	.....
Excavations, drainage, etc	518	85	55	51	460	215	1,384	**32,968**	262
Streets and roads	1,077	11,174	4,941	5,885	9,549	1,877	34,503	**592,128**	1,163
Industrial buildings	4,468	24,328	3,875	5,080	5,020	606	43,377	**330,272**	9,180
Commercial buildings	12,919	76,840	4,622	37,051	16,194	7,857	155,483	**1,741,146**	7,986
Federal government	287	4,516	924	68	372	324	6,491	**66,325**	.....
Unclassified	164	18,304	1,783	923	87	12,400	33,661	**272,988**	3,641
November, 1928*	19,947	147,593	17,984	53,751	36,245	30,509	306,029	.....	22,682
October, 1928†	12,556	156,484	45,146	56,319	51,463	30,666	352,634	.....	14,900
November, 1927†	15,035	76,183	52,792	61,627	30,813	20,872	257,322	.....	11,355
Year to date, 1928	**208,969**	**1,316,471**	**266,474**	**758,253**	**484,183**	**307,138**	.....	**3,341,488**	**154,735**
Year to date, 1927	212,624	854,869	260,416	709,228	493,467	345,318	2,875,922	.....	129,687

*Five weeks. †Four weeks.






Engineering News-Record
CONSTRUCTION COST INDEX NUMBER
1913 = 100
1927
1928
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.



ENGINEERING NEWS-RECORD CONSTRUCTION COST AND VOLUME INDEX NUMBERS

Construction Volume 16.2 Per Cent Over Last Year

As the year draws to a close the prosperous condition in the general construction industry becomes apparent. The accumulated total volume of contracts awarded for the first eleven months of the current year was $3,341,488,000, against $2,875,922,000 for a similar period in 1928, or an increase of 16.2 per cent. This rate of twelve-month growth is almost exactly the same rate of growth which was reported for the year 1927 over 1926. It now seems probable that the 1928 increase in the volume of contracts let over those let last year will probably exceed $450,000,000.

Only three classes of general construction—sewers, bridges and excavations—will probably finish the year with a volume of projects under that of 1927. The greatest increase has taken place in commercial buildings. For the eleven-month period closing with November the volume of contracts awarded for commercial buildings totaled $1,741,146,000, against $1,456,707,000 during the same period last year. This is an increase in the construction of commercial structures of almost 20 per cent, which is just double the increase reported for 1927 over 1926. In fact, the volume of contracts awarded for commercial building during the first eleven months of the current year exceeded the total for the entire year of 1927 by $110,000,000.

Construction Cost and Volume Index Numbers

E.N.-R. Cost		E.N.-R. Volume	
Dec. 1928	**$210.16**	**Nov. 1928**	**251**
Nov., 1928	209.46	Oct. 1928	363
Dec., 1927	203.90	Nov., 1927	272
Peak June, 1920	273.80	1927 (average)	263
1927 (average)	206.24	1926 (average)	228
1913 (average)	100.00		
1927		1927	
January	211.50	January	187
February	210.15	February	182
March	208.80	March	226
April	209.00	April	257
May	206.80	May	299
June	205.55	June	297
July	203.68	July	25-
August	205.50	August	30(
September	203.60	September	273
October	204.40	October	26?
November	201.98	November	272
December	203.90	December	319
1928		1928	
January	203.90	January	208
February	204.65	February	225
March	204.65	March	318
April	206.40	April	316
May	207.00	May	299
June	206.15	June	308
July	206.65	July	266
August	207.29	August	306
September	207.29	September	296
October	207.71	October	363

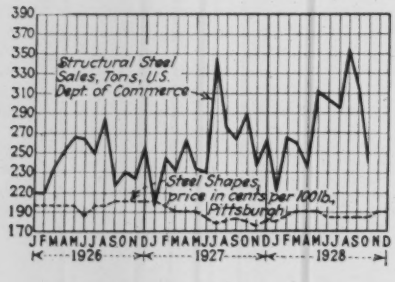
The second greatest increase is being recorded in the construction of new streets and roads. There appears to be every probability that the total volume of contracts awarded during the current year for streets and roads will reach the record figure of $625,000,000, or an increase of about $100,000,000 over 1927. Here again the volume of contracts awarded during the first eleven months of the current year exceeded the total for the entire year 1927, in this instance by $67,000,000.

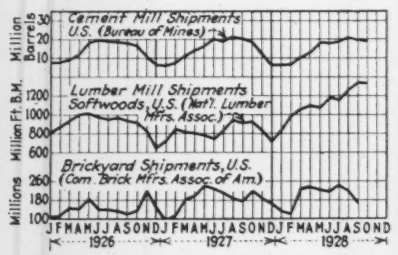
Industrial buildings constructed during 1928 should exceed 1927 by about $80,000,000, water-works by about $40,000,000 and federal government projects by $20,000,000. The unclassified group should exceed last year's volume by about $10,000,000.

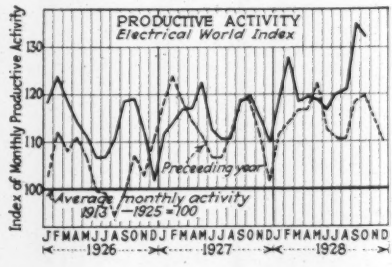
The greatest drop in volume of construction during the current year is being recorded by sewers. For the eleven-month period the contracts awarded for sewers are almost 15 per cent under the same period last year. The current year will be the first year in some time that the volume of new sewer construction has shown a drop. Bridges will probably record a drop this year of around $8,000,000, and a similar drop will be reported for excavation contracts. Both of these groups recorded a material increase in 1927 over 1926.

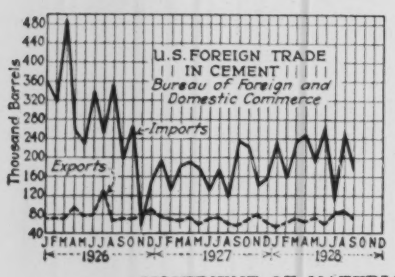
The greatest gain in volume of construction during the current year is being recorded in the Middle Atlantic States. It now seems probable that the total 1928 general construction in this section will exceed the figures of last year by almost $500,000,000, a gain of about 54 per cent over 1927. No other section of the nation is recording anything like such a national growth as this. The current November volume of contracts awarded in this section was almost exactly double that reported for November last year—an increase of $71,000,000 being recorded.

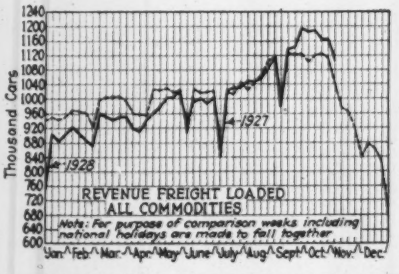
The Middle Western States are recording a 7 per cent increase in volume of contracts awarded, and the South also

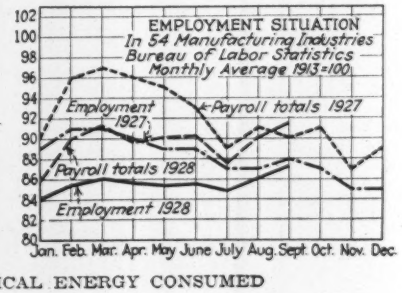

Structural Steel Sales, Tons, U.S. Dept. of Commerce
Steel Shapes, price in cents per 100 lb., Pittsburgh
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928


Million Barrels
Cement Mill Shipments U.S. (Bureau of Mines)
Million Ft. B.M.
Lumber Mill Shipments Softwoods, U.S. (Nat'l. Lumber Mfrs. Assoc.)
Millions
Brickyard Shipments, U.S. (Com. Brick Mfrs. Assoc. of Am.)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928


PRODUCTIVE ACTIVITY
Electrical World Index
Index of Monthly Productive Activity
Preceding year
Average monthly activity 1913 — 1925 = 100
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928


U.S. FOREIGN TRADE IN CEMENT
Bureau of Foreign and Domestic Commerce
Thousand Barrels
Imports
Exports
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928


Thousand Cars
1927
1928
REVENUE FREIGHT LOADED ALL COMMODITIES
Note: For purpose of comparison weeks including national holidays are made to fall together
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.



MOVEMENT OF MATERIALS—EMPLOYMENT SITUATION—ELECTRICAL ENERGY CONSUMED

exceeds last year by a few million dollars. On the other hand, New England, the section west of the Mississippi and the Far West are all recording a drop under 1927—the drop in the Western States reaching the proportion of 11 per cent.

Canadian construction during the current year is keeping on a plane almost 20 per cent above last year, but the figures for the current November were about 50 per cent above those of November last year.

National Labor Conditions Continue Satisfactory

Increased industrial activity in eight out of 21 representative cities is reflected in reports received this week by *Engineering News-Record*. In ten of the cities reporting, industry proceeded at about the same rate as in November.

The cities in which there is an upward movement in volume of general trade, with unemployment not above the usual seasonal levels in manufacturing and construction crafts, are Cleveland, Chicago, Baltimore, San Francisco, New Orleans, Detroit, Cincinnati and New York. Birmingham, Philadelphia and St. Louis, on the other hand, report conditions unfavorable, particularly among building trades mechanics. In the first two cities there is widespread unemployment in all trades. St. Louis union officials state that 35 per cent of a membership of 18,000 men are out of work. This slump mainly affects painters, electricians, plasterers, iron workers, bricklayers, hodcarriers and common laborers.

Strikes are conspicuously absent from the building trades, just as they were in the first week of December last year. Three strikes of major importance were, on the other hand, active on Dec. 1, 1926. These controversies involved carpenters in San Francisco, building laborers in Boston and electricians in St. Louis.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.25@1.40	$0.60@0.70	$0.60@1.00	$0.50	.....	$0.75@1.25	$0.25@.35
Baltimore	1.62½	1.00@1.10	1.00@1.37½	1.00	$0.65	1.00@1.25	.35
Birmingham	1.50	1.00	1.25	.50	.....	1.75	.25@.40
Boston	1.50	1.35½	1.37½	.85	1.27½	1.37½	.45@.80
Cincinnati	1.50	1.37½	1.37½	.92½	1.37½	1.37½	.45@.60
Chicago	1.62½	1.50	1.00@1.50	.90@.96¼	1.50	1.50	.90
Cleveland	1.62½	1.37½	1.37½	.87½	1.10	1.50	.87½
Dallas	1.67½	1.12½	1.25	.40@.75	1.25	1.25	.35@.50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00		1.25	.37½@.62½
Detroit	1.56¼	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.50@.60
Kansas City	1.50	1.25	1.25	.90	1.25	1.25	.35@.75
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.50
Minneapolis	1.25@1.37½	.87½@.95	.87½	.75	.....	1.00	.45@.60
Montreal	1.25	.85	.75	.45	.50	1.00@1.10	.35@.40
New Orleans	1.50	.90	1.25	.75	.80@1.00	1.25	.30@.40
New York	1.75	1.50	1.75	1.12½	1.00@1.12½	1.75	.90½
Philadelphia	1.62½	1.12½@1.25	1.02½	.70@1.12½	1.00	1.37½@1.50	.45@.75
Pittsburgh	1.70	1.50	1.43¾@1.56¼	1.12½	.....	1.50	.41@.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.50	.45@.75
San Francisco	1.37½	1.12½	1.00@1.12½	.87½	1.12½	1.37½	.50@.60
Seattle	1.50	1.12½	1.25	1.00	1.12½	1.25	.70

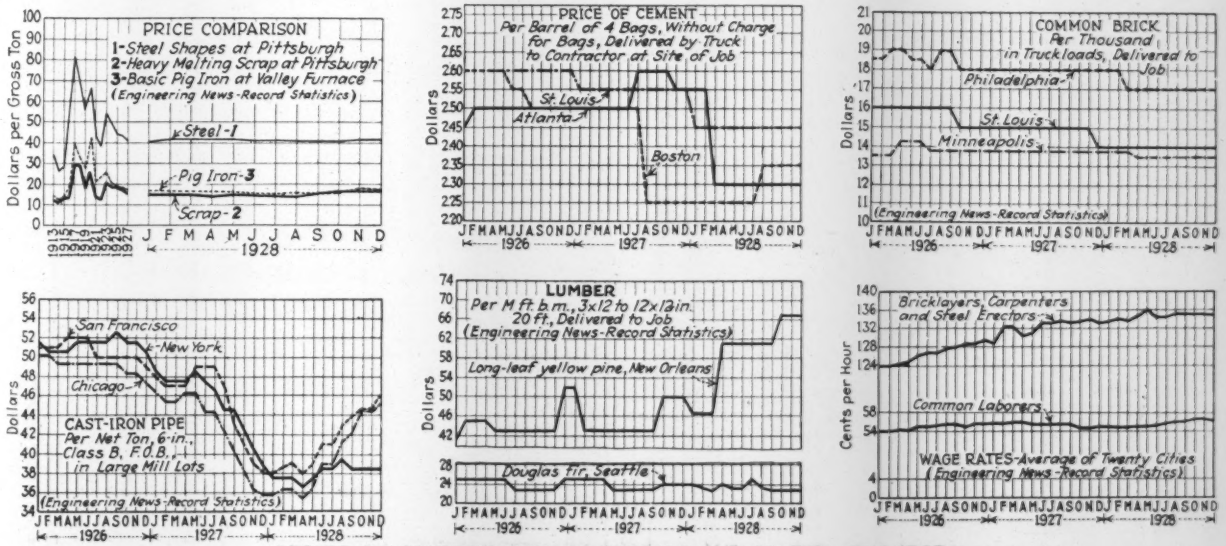
The average skilled building trades rate for the country is $1.35⅓ per hour, which rate has held since Oct. 1, 1928. In December, 1927, the rate was $1.33⅓ per hour. Common laborers receive an average rate of 56.28c. per hour, compared with 56.53c. per hour in November and 55c. per hour in December, 1927.

The limited number of minor wage adjustments which took effect during the last month were not sufficiently important to disturb the national average. Carpenters, for instance, were reduced 2c. per hour, to $1.35½, in Boston. This craft was however advanced 10c. per hour to 85c., at Montreal. Bricklayers in Montreal were advanced 13c. per hour, to $1.25. Hodcarriers were advanced 10 to 15c. per hour, to a range of $1.15 to $1.25, in St. Louis. This craft was also advanced 5c. per hour, to 45c., at Montreal. Structural ironworkers in Montreal were advanced 10c. per hour, to a range of $1 to $1.10. The minimum wage for common laborers in Pittsburgh was reduced 10c., to 40c. per hour, while the rates for this class in Montreal advanced 5c., to a range of 35 to 40c. per hour.

November Construction Awards 8 Per Cent Under Last Year

The *Engineering News-Record* Construction Volume Index for November discloses a rather radical drop in the volume of contracts being awarded for general construction projects. The November index of 251 is 31 per cent under October, whereas last year the November index exceeded the October index by 1.2 per cent. The current November index is also about 8 per cent under that of November last year. This is the second successive month in which the volume of new construction contracts awarded has been under that of the same month last year.

The upward trend in the Construction Cost Index which started last December has continued up to the present, the current December cost index being 3 per cent above December last year and 0.3 per cent above last November. The December index, however, while the highest since January, 1927, yet is still 23.3 per cent under the peak of June, 1920.


PRICE COMPARISON
1-Steel Shapes at Pittsburgh
2-Heavy Melting Scrap at Pittsburgh
3-Basic Pig Iron at Valley Furnace
(Engineering News-Record Statistics)
Steel-1
Pig Iron-3
Scrap-2
Dollars per Gross Ton
J F M A M J J A S O N D
1928
PRICE OF CEMENT
Per Barrel of 4 Bags, Without Charge for Bags, Delivered by Truck to Contractor at Site of Job
St. Louis
Atlanta
Boston
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928
COMMON BRICK
Per Thousand in Truckloads, Delivered to Job
Philadelphia
St. Louis
Minneapolis
(Engineering News-Record Statistics)
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928
San Francisco
New York
Chicago
CAST-IRON PIPE
Per Net Ton, 6-in., Class B, F.O.B., in Large Mill Lots
(Engineering News-Record Statistics)
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928
LUMBER
Per M ft. b.m., 3x12 to 12x12 in. 20 ft., Delivered to Job
(Engineering News-Record Statistics)
Long-leaf yellow pine, New Orleans
Douglas fir, Seattle
Dollars
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928
Bricklayers, Carpenters and Steel Erectors
Common Laborers
WAGE RATES-Average of Twenty Cities
(Engineering News-Record Statistics)
Cents per Hour
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1926 1927 1928

PRICES OF CONSTRUCTION MATERIALS AND WAGES OF LABOR

Current Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

Building Materials

PORTLAND CEMENT—Prices per bbl., delivered to contractors, in carloads, *without charge for bags*. Cash discount not deducted.

	Dec. 6, 1928	One Month Ago	One Year Ago
Atlanta	*$2.10*	$2.30	$2.45
Baltimore	2.65	2.65	2.50
Birmingham	2.60	2.60	2.40
Boston	2.35	2.35	2.05f.o.b.
Cedar Rapids (f. o. b.)	2.24	2.24	2.24
Chicago (f. o. b.)	2.05	2.05	2.05
Cincinnati (f. o. b.)	2.22	2.22	2.32
Cleveland (f. o. b.)	2.24	2.24	2.24
Dallas	2.15	2.15	2.05f.o.b
Davenport (f. o. b.)	2.24	2.24	2.24
Denver	2.55	2.55	2.85
Detroit (f. o. b.)	1.95	1.95	2.00
Duluth (f. o. b.)	2.04	2.04	2.04
Indianapolis, (f. o. b.)	2.19	2.19	2.19
Jersey City	2.35	2.35	2.13f.o.b.
Kansas City, Mo	2.20	2.17	2.07f.o.b.
Los Angeles	2.66	2.66	2.56
Milwaukee (f. o. b.)	2.20	2.20	2.20
Minneapolis (f. o. b.)	2.22	2.22	2.22
Montreal (f. o. b.)	1.41	1.41	1.41
New Orleans	*2.35*	2.40	2.07f.o.b.
New York	2.25@2.35	2.25@2.35	2.25@2.35
Peoria (f. o. b.)	2.22	2.22	2.22
Philadelphia	2.41	2.41	2.40
Pittsburgh (f. o. b.)	2.04	2.04	2.04
St. Louis	2.45	2.45	2.05f.o.b.
St. Paul (f. o. b.)	2.22	2.22	2.22
San Francisco	2.41	2.41	2.51
Seattle	2.70	2.70	2.65
Toledo (f. o. b.)	2.20	2.20	2.20

Current mill-prices per barrel, in carloads, without bags, f.o.b.:

Alpena, Mich.	$1.65	Leeds, Ala.	$1.65
Buffington, Ind.	1.80	Lehigh Valley District	1.75
Clinchfield, Ga.	1.65	Mason City, Ia.	1.80
Fordwick, Va.	2.05	Mitchell, Ind.	1.90
Hannibal, Mo.	1.90	North Birmingham, Ala.	1.45
Hudson, N. Y.	1.75	Richard City, Tenn.	1.85
Iola, Kan.	1.85	Steelton, Minn.	1.85
Kingsport, Tenn.	2.05	Universal, Pa.	1.80
La Salle, Ill.	1.90	Wyandotte, Mich.	1.70

SAND AND GRAVEL—Prices are per cu.yd., delivered. Weight of sand, 1½ tons per cu.yd.; gravel, 1½ tons per cu.yd., unless otherwise specified in pounds.

	Gravel		Sand
	1½ In.	¾ In.	
Atlanta, per ton	$3.50	$3.50	$2.50
Baltimore, per ton	2.40	2.60	1.70
Birmingham (2,600 lb.)	3.00	3.00	2.65
Boston, per ton	**2.00**	**2.00**	**1.50**
Chicago	2.05@2.20	2.05@2.20	2.05@ 2.20
Cincinnati, per ton	1.90	1.90	1.60
Cleveland	2.70	2.70	2.50
Dallas	2.50	2.50	2.25@ 3.00
Denver (2,700 lb.)	1.80	1.80	1.30
Detroit (2,600 lb.)	*3.00*	*3.00*	*2.50*
Kansas City, Mo.	2.40	2.40	...
Los Angeles, per ton	2.15	2.15	1.30
Minneapolis (2,800 lb.)	2.25 ton	2.25 ton	1.00
Montreal, per ton	1.90	1.50	1.20
New Orleans (2,700 lb.) (2,500 lb.)	3.00	3.00	2.00
New York	3.25@3.50	3.25@3.50	2.00@ 2.25
Philadelphia, per ton	2.05@2.90	2.05@2.90	1.40@ 2.25
Pittsburgh, per ton	2.40	2.40	2.60
St. Louis, per ton	1.90	1.90	1.60@1.90
San Francisco (2,800 lb.)	1.80	1.80	1.40
Seattle (3,200 lb.) (2,850 lb.)	2.00	2.00	2.00

Note: New York gravel weighs 2,800@3,000 lb. and sand, 2,700 lb.

CRUSHED STONE—Prices are per cu.yd., delivered. Weight, 1½ tons per cu.yd., unless otherwise specified in pounds:

	1½ In.	¾ In.
Atlanta, per ton	**$3.50**	**$3.50**
Baltimore, per ton	2.75	2.85
Birmingham, Limestone	**3.00**	**3.25**
Boston, per ton	**2.40**	**2.40**
Chicago, Limestone	2.05@2.20	2.05@2.20
Cincinnati, per ton	**2.50**	**2.50**
Cleveland, per ton	3.00	3.00
Dallas	3.25	3.40
Denver, Granite (2,700 lb.)	2.50	2.50
Detroit, Limestone, per ton	2.50	2.60
Kansas City, Limestone, (2,450 lb.)	2.00	2.00
Los Angeles, per ton	2.15	2.15
Minneapolis, Limestone, per ton	2.25	2.25
Montreal, per ton	2.10	2.10
New York, Limestone	3.25@3.50	3.25@3.50
Philadelphia, Limestone, per ton	2.30@3.15	2.30@3.15
Pittsburgh, per ton	2.75	2.75
St. Louis, per ton (2400 lb. per cu.yd.)	1.90	1.90
San Francisco, Trap rock (2,400 lb.)	1.70	1.70
Seattle, (2,700 lb.)	1.90	1.90

CRUSHED SLAG—Price of crushed slag in carloads, per net ton, at plant:

	1½-In.	¾-In.	†Roofing	Sand
Birmingham, Ala.	$0.90	$1.25	$2.05	$0.80
Buffalo District	1.25	1.35	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.30
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	....	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown District	1.30	1.40	2.00	1.30

HOLLOW TILE—Price of hollow building tile per block, delivered to contractor in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.072	$0.136	$0.163	$0.181	$0.2232
Baltimore	.095	.....	.175	.....	.232
Birmingham	.09	.127	.174	.218	.261
Boston	.08	**.105**	**.145**	**.185**	**.25**
Chicago	.076	.104	.142	.182	.202
Cincinnati	.074	.105	.136	.175	.205
Cleveland	.064	.088	.128	*.171*	.19
Dallas	.096	*.12*	.1785	.251	.284
Denver	.0975	.135	.175	.2125	.25
Detroit	**.096**	**.132**	.18	.256	.293
Kansas City	**.06**	.....	.158	.....	**.25**
Los Angeles	.085	.122	.175	.232	.285
Minneapolis	*.0675*	.0845	*.131*	.134	*.1806*
Montreal	.12	.....	.22	.....	.315
New Orleans	.09	.125	*.162*	.22	.245
New York	*.0864*	*.1296*	*.162*	.....	.....
Perth Amboy, N.J. (f.o.b.)	.....	.....	.....	.252	.312
Philadelphia	.11	.145	.22	.27	.34
Pittsburgh	.068	.....	.1175	.....	.1726
St. Louis	.078	.105	.145	.175	.21
San Francisco	.108	.156	.255	.....	.....
Seattle	*.08*	.11	.18	.....	.....

BRICK—Contractors price, delivered, per thousand, is as follows:

		Paving	
	Common	3x8½x4-in.	3½x8½x4-in
Atlanta	$14.75	$38.00*	$45.00†
Baltimore	15.00	40.00	45.00
Birmingham	15.00	32.00*	36.00†
Boston	17.25	45.00	50.00
Chicago	12.00	42.00	45.00
Cincinnati	18.00	40.00	45.00
Cleveland	14@16	33.00	36.00
Dallas	*12.50*	35.00	.....
Denver, salmon	12.00	.....	.....
Detroit	15.50	35.50	38.50
Kansas City	14.00	.....	.....
Los Angeles	11.00	.....	.....
Minneapolis	13.50	.....	.....
Montreal	20.33	.....	.....
New Orleans	16.00	40.00*	**50.50**
New York	16@19	45.00	51.00
Philadelphia	17.00	40.00	46.00
Pittsburgh	17.00	.....	.....
St. Louis, salmon	*13.00*	**40.00**	**45.00**
San Francisco	13.00	.....	.....
Seattle	14.00	50.00	55.00

*2½x8½x4 in. †3x8½x4.

LIME—Prices delivered to job:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
Atlanta	$27.50	**$17.50**	$2.30†	$2.10†
Baltimore	20.00	14.00	2.55†	.....
Birmingham	22.00	16.00	**3.00**†	**2.00**†
Boston	**21.00**	**14.50**	*3.80**	*2.90**
Chicago	20.00	18.00	20.00‡	1.50†
Cincinnati	**18.00**	13.20	.....	13.20‡
Cleveland	20.00	16.00	2.50†	2.50†
Dallas	20.00	.....	.....	18.00‡
Denver	32.00	23.75	3.80*	3.00*
Detroit	19.20	14.80	2.20†	2.20†
Kansas City	24.00	13.00	2.75†	2.50†
Los Angeles	25.00	18.00	2.85†	17.00‡
Minneapolis	25.50	21.00	.....	1.70†
Montreal	21.00	21.00	.....	15.00‡
New Orleans	.....	.....	2.60	1.40†
New York	21.00@22.00	14.00@15.00	4.00@4.10*	3.15@3.25*
Philadelphia	22.00	15.00	.....	.....
Pittsburgh	**21.00**	**19.00**	18.00‡	17.00‡
St. Louis	*15.00*	*11.25*	2.50†	2.10†
San Francisco	27.50	20.00	.....	1.70†
Seattle, paper sacks	36.00	24.00	.....	2.80†

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡Per ton.

CONCRETE BLOCKS—Standard, 8x8x16-in., hollow, delivered to job, each:

Boston	$0.18@.20	Minneapolis, f.o.b.	*$0.12*
Brooklyn and Queens	.15@.17	New Orleans	.22
Cleveland	.17@.18	Philadelphia	.18@.25
Denver	.22	Pittsburgh	.20
Detroit	.15	St. Louis	.18

SLATE—Slab work, f.o.b. cars, Bangor, Pa., per sq.ft.:

Thickness	1 to 10 Sq.Ft.	10 to 16 Sq.Ft.	16 to 22 Sq.Ft.	22 to 28 Sq.Ft.	28 to 35 Sq.Ft.	35 to 40 Sq.Ft.
1-in.	$0.30	$0.36	$0.44	$0.52	$0.62	$0.77
2-in.	.50	.60	.68	.76	.86	1.01

Road and Paving Materials

PAVING STONE—Prices, f.o.b., in carloads or in cargo lots, for granite blocks 4x8x4-in., dressed:

Atlanta	$3.00 per sq.yd.
Baltimore	3.00 per sq.yd.
Boston	135.00 per M.
Chicago, 5 in.	3.25@ 3.90 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	115@120 per M
Detroit, 5 in.	3.00 per sq.yd.
Kansas City	3.50 per sq.yd.
Minneapolis, Sandstone	2.74 per sq.yd.
Montreal	104.75 per M.
New Orleans	2.75 per sq.yd.
New York, 5 in., Grade 1, 30 blocks per sq.yd.	150.00 per M.
Philadelphia	125.00 per M.
St. Louis	3.30@3.40 per sq.yd.
San Francisco, Basalt block, 4x7x8	70.00 per M.

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING—Prices f.o.b. in carloads:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.40
Chicago	3½	16	2.10
Cincinnati	3½	16	2.35
Dallas	4	18	3.90
Kansas City	3½	16	3.85
Minneapolis	3½	16	2.75
Montreal	4	16	4.50
New Orleans	3½	16	2.30
New York	3½	16	2.70
St. Louis	3½	16	2.30

FLAGGING—Prices in fair-sized quantities, alongside dock, New York: Manhattan and Bronx, 4 ft. wide, 24c. per sq.ft.; Queens, 5 ft. wide, 26c. per sq.ft.

CURBING—*New York*: Bluestone, f.o.b. barge, New York, 5x16 in., rough, 90c. per lin.ft., cutting charges extra. *Birmingham*: Limestone, 5x18-in., f.o.b., $1.05 per lin.ft. *St Louis*: Class "B" straight, delivered, 5x16 in., 80c. per lin. ft.; roundings, $1.15 per lin.ft.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
Atlanta (Mexican)	$22.60	$18.40
Baltimore (Standard Oil, f.o.b. refinery)	21.75	17.75
Birmingham (Mexican)	27.00	.....
Boston (Mexican)	24.50	18.25
Chicago (Texas)	24.50	21.30
Cincinnati (Kentucky Rock)	.....	11.65
Cleveland	24.50	20.50
Dallas (Texas)	26.00	.....
Denver (California)	35.00	.....
Detroit (Mexican)	24.00	19.00
Kansas City, Mo. (Texas)	27.30	*22.30*
Los Angeles ("D" Grade, California, f.o.b. El Segundo)	18.00	12.00
Maurer, N. J. (Bermudez)	30.00	.....
Maurer, N. J. (Trinidad)	23.00	.....
Minneapolis, (Stanolind, f.o.b. Twin Cities)	29.10	20.10
Montreal (Imperial)	28.00	21.50
New Orleans (Texas)	**24.00**	**21.00**
New York (Texas)	24.50	16.50
Philadelphia (Mexican)	20.00	18.00
Pittsburgh	*26@30*	*16@18*
St. Louis (Mexican)	23.50	19.50
San Francisco, (f.o.b. refinery, Oleum, Calif.)	18.00	12.00
Seattle, ("D" grade, California, f.o.b Richmond refinery)	19.50	13.50

*At refinery.

ROAD OILS—Price, f.o.b. in tank cars, 8,000 gal. minimum, per gal.:

Birmingham, 40@50% asphalt	$0.0525
Birmingham, 50@60% asphalt	.0475
Dallas, 40@50% asphalt	.06
Dallas, 50@60% asphalt	.06
New York, 40@50% asphalt (at terminal)	.06
New York, 50@60% asphalt (at terminal)	.06
St. Louis, 40@50% asphalt	**.0394**
St. Louis, 50@60% asphalt	**.0394**

Iron and Steel

PIG IRON—Per gross ton, f.o.b.:

Birmingham, No. 2 fdry., silicon 1.75@2.25	$16.25
Pittsburgh, basic, incl. freight ($1.76) from Valley	19.26

STRUCTURAL STEEL—Per 100 lb.:

	Shapes, 3 to 15-In.	Plates, ¼-In
Birmingham, large mill lots, f.o.b.	$2.15	$2.15
Chicago, warehouse, delivered	3.10	3.10
Cleveland, warehouse, delivered	3.00	3.00
Dallas, warehouse, delivered	*3.50*	3.50
New York, warehouse, delivered, 250 to 3,999 lb	3.30	3.30
Pittsburgh, large mill lots, f.o.b.	1.90*	1.90*
St. Louis, warehouse, delivered	3.25	3.25
San Francisco, warehouse, delivered	**3.25**	**3.25**

*As of Nov. 29, 1928.

BARS, CONCRETE REINFORCING—Per 100 lb. for ½-in.:

Birmingham, large mill lots, f.o.b.	$2.15
Chicago, warehouse, delivered	2.30@3.00
Cleveland, warehouse, delivered	2.25@3.00
Dallas, warehouse, delivered	3.50
New York, warehouse, delivered, 250 to 3,999 lb	**2.85**@3.25
Pittsburgh, large mill lots, stock lengths, f.o.b.	2.00
St. Louis, warehouse, delivered	3.15
San Francisco, warehouse, delivered	2.25

EXPANDED METAL LATH—Per 100 sq.yd., painted, delivered to job in less-than-carload lots:

Lb. per Sq. Yd.	New York	Birmingham	Chicago	St. Louis	Dallas	San Francisco
2.2	$15.00	$19.00	$14.00	*$18.00*	$21.50	$18.50
2.5	16.00	20.00	15.00	*19.00*	24.00	19.50
3.0	17.50	22.50	16.50	21.00	.....	22.00
3.4	20.00	24.50	18.00	22.50	30.00	24.00

WIRE REINFORCEMENT FOR CONCRETE—Price per 100 sq.ft.in carloads at mills; from warehouses in lots of 10,000 sq.ft. or over; plain 4 in. by 4 in. mesh:

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York	Warehouse: St. Louis	Warehouse: Dallas	Warehouse: San Francisco
032	22	$0.99	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.26	1.29	1.76	1.35	1.38	1.55
068	35	1.54	1.58	2.18	1.66	1.67	1.91
093	45	1.98	2.03	2.79	2.13	2.00	2.46
126	57	2.45	2.51	3.45	2.63	2.55	3.03
153	68	2.92	2.99	4.13	3.14	3.15	....
180	78	3.35	3.43	4.73	3.60	3.47	....

STEEL SHEETS—Per 100 lb.:

	Blue Annealed No. 10	Black No. 24	Galvanized No. 24
Chicago, warehouse, delivered	$3.35	$3.80	$4.65
Cleveland, warehouse, delivered	3.25	3.50	4.35
New York, warehouse, delivered	3.90*	4.20	4.95
Pittsburgh, large mill lots, f.o.b.	2.00@2.10	2.75@**2.85**	3.50@3.60
St. Louis, warehouse, delivered	3.45	4.10	4.95
San Francisco, warehouse, delivered	*3.90*	*4.50*	5.40

*250 to 3,999 lb.

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	20%
Galvanized iron rigging and guy rope (add to list)	12½%
Galvanized steel rigging and guy rope	7½%
Plow steel round strand rope	35%
Round strand iron and iron tiller	5%
Special steel round strand rope	30%

Discount 5 points less than discount for Eastern territory: California, Oregon, Nevada, Washington, Wyoming, New Mexico, Colorado, North Dakota, Nebraska, Kansas, Oklahoma and Texas. Discount 10 points less than discount for Eastern territory: Arizona, Montana, Idaho and Utah.

RIVETS—Per 100 lb.; ½-in., full packages:

	Round-head Structural	Cone-head Boiler
Chicago, warehouse, delivered	$3.60	$3.60
Dallas, warehouse, delivered	*4.80*	*4.80*
New York, warehouse, delivered	5.00	5.00
Pittsburgh, large mill lots, f.o.b.	2.80@2.90	2.80@2.90
St. Louis, warehouse, delivered	3.75	3.75
San Francisco, warehouse, delivered	5.75	5.75
Seattle, warehouse, delivered	3.75	3.75

STEEL SHEETPILING—The base price, f.o.b., Pittsburgh, for large mill lots is $2.25 per 100 lb.

TERNE PLATE—I C, 8-lb. coating, 20x28-in., f.o.b., Pittsburgh, per package $11.20

SHIP SPIKES—Per 100 lb., black, from warehouse stocks; galvanized are about $1.75 per 100 lb. higher:

	½-In.	⅝-In.	¾-In.
San Francisco	**$6.55**	**$6.10**	**$5.75**
Seattle	7.75	5.65	5.50

Pittsburgh base in lots of 200 kegs or more, $3.00 per 100 lb.

WIRE NAILS—The following quotations are per 100 lb. keg, delivered from warehouse stocks, also Pittsburgh mill base:

Pittsburgh Mill	Birmingham	Chicago	St. Louis	Dallas	San Francisco	Montreal
$2.55@**$2.65**	**$3.30**	$3.10	**$3.05**	$3.75	$3.35	$4.95

SCRAP—The prices following are, f.o.b., per ton, paid by dealers:

	New York Per Gross Ton	Chicago Per Gross Ton	Detroit Per Gross Ton
No. 1 railroad wrought	**$12.25@$12.75**	**$14.75@$15.25**	.....
Stove plate	**9.50**	14.00@14.50	$10.00@$10.50*
No. 1 machinery cast	15.00@16.00	16.50@17.00	**14.00***
Machine shop turnings	*7.25@7.50*	**8.50@9.00**	*8.00*
Cast borings	*6.75@7.00*	**11.75@12.25**	**9.50**
Railroad malleable	10.00@10.50	**16.00@16.50**	14.50@15.00†
Re-rolling rails	**13.00@13.50**	16.50@17.00	**13.50**
Re-laying rails, 56@60 lb.	23.00@24.00	23.00@25.00	.....
Heavy melting steel, No. 1	*11.75@12.00*	**14.50@15.00**	**14.00**
Iron and steel pipe	10.75	11.50@12.00	.....

*Net ton. †Automotive.

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carload lots of 36,000 lb. or 18 tons:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.71*
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15†
Chicago	.34	Philadelphia	.32
Cincinnati	.27	St. Louis	.405
Cleveland	.19	St. Paul	.60
Denver	1.15†		

*Except iron or steel pipe and fittings. †Minimum weight on structurals, 60,000 lb.

Railway Materials and Supplies

STEEL RAILS—Per gross ton, f.o.b., for large mill lots:

	Pittsburgh	Birmingham	Chicago
Standard bessemer rails	$43.00	$43.00	$43.00
Standard openhearth rails	43.00	43.00	43.00
Light rails, 25 to 45 lb.	36.00	34@36	36@38
Re-rolled rails	30@32	34@36	

RAILWAY TIES—For fair-sized orders, f. o. b., the following prices per tie hold:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
New York	Long-leaf sap pine, untreated	$1.10	$1.30
	Creosoted—prices on application.		
Birmingham	Southern pine, untreated	1.10	1.25
	Southern pine, creosoted	1.60	1.75
Chicago	White oak, untreated	1.40	1.78
	Oak, empty cell, creosoted	1.80	2.40
	Oak, zinc treated	1.60	2.10
	Southern pine, creosoted	1.60	2.10
St. Louis	White oak, untreated	1.10	*1.65*
	Red oak, creosoted	*1.50*	*2.05*
San Francisco	Sap pine or cypress, untreated	.80	*1.20*
	Douglas fir, green, untreated	.82	1.14
	Douglas fir, empty cell, creosoted	1.73	2.32
Montreal	Birch or maple, untreated	.75	1.25
	Birch or maple, creosoted	1.25	1.55

Current Prices of Construction Materials

Railway Supplies—Continued

TRACK SUPPLIES—Per 100 lb., f.o.b., Pittsburgh mill, for large mill lots, together with warehouse prices at other places named:

	Pittsburgh	Chicago	Birmingham	St. Louis	San Francisco
Standard spikes, ⅝-in. and larger	$2.80	$3.55	$3.50	$3.65@$3.75	$3.85
Track bolts	*3.60*	4.55	4.50	4.65@4.75	4.85
Standard section angle bars, splice bars or fish plates	2.75	3.40	3.50	4.00@6.00	4.25
Tie plates	2.15	2.15*	2.15	2.00@3.20	.....

*At Chicago mills in carloads.

Pipe

WROUGHT-STEEL PIPE—Discounts from standard list:

	1 to 3-In. Butt Weld		2½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Chicago, warehouse, delivered	54%	41%	51%	38%
Cleveland, warehouse, delivered	55½%	43½%	53½%	40½%
New York, warehouse, delivered	50%	36%	45%	32%
Pittsburgh, large mill lots, f.o.b.	62%	50½%	59%	47½%
St. Louis, warehouse, delivered	49%	36%	46%	33%

CAST-IRON PIPE—Price per net ton, for bell and spigot pipe, Class B and heavier, f.o.b., in large mill lots:

	4-In.	6-In. and Over
Birmingham mill	$39.00	$36.00
Burlington (N. J.) mill	39.00	36.00
Chicago	48.20@49.20	45.20@46.20
New York	41.60	38.60
Pittsburgh	47.50	44.50
St. Louis	44.60	41.60
San Francisco	49.00	46.00

Gas pipe and Class A, $3.00 per ton extra.

SEWER PIPE—Prices delivered, in cents per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.20	$0.34	$0.75	.....	$1.70	.....	.....
Baltimore	.16	.24	.46	.....	1.83	.....	$6.50
Birmingham	.25	.40	.65	$1.50	2.75	$3.90	5.83
Boston	.175	.285	.53	1.25	2.05	3.25	5.70
Chicago	.16	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.144	.224	.432	.80	1.44	2.304	4.8175
Cleveland	.18	.28	.54	1.30	2.34	4.68	8.18
Dallas	.256	.42	.80	1.70	3.00	.....	.....
Denver	.161	.23	.414	.816	1.44	.....	.....
Detroit	.18	.28	.6075	1.50	2.70	5.12	7.91
Kansas City	.21	.29	.52	.....	1.90	3.80	.....
Los Angeles	.21	.2825	.51	1.186	2.03	3.39	5.09
Minneapolis	.1575	.25	.45	.85	1.80	3.75	4.94
Montreal	.36	.53	.78	1.48	2.75	4.20	.....
New Orleans	.195	.325	.5525	*.969*	*1.8525*	.....	.....
New York	.20	.32	.61	1.50	2.70	5.12	7.91
Philadelphia	.117	.182	.351	1.025	1.845	3.60	5.6375
Pittsburgh	.0945	.147	.2835	.90	1.62	3.024	4.8175
St. Louis	.1645	.26	.468	.78	1.872	3.65	4.80
San Francisco	.21	.30	.54	1.32	2.16	3.60	.....
Seattle	.22	.30	.54	1.26	2.16	3.60	.....

CLAY DRAIN TILE—Prices are delivered per 1,000 lin.ft.:

Size, In.	New York	Birmingham	St. Louis	Dallas	San Francisco	Seattle
3	*$40.00*	$45.00	$50.00	.....	.....	$40.00
4	*45.00*	56.00	50.00	$73.00	$67.50	60.00
5	50.00	80.00	.....	110.00	86.25	.....
6	*78.00*	105.00	85.00	118.00	112.50	90.00
8	*130.00*	175.00	195.00	150.00	175.00	.....

Miscellaneous

LINSEED OIL—Raw oil, f.o.b. in 1- to 4-bbl. lots, per lb.:

New York $0.11 Chicago $0.114 Minneapolis $0.119

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b., New York: White, dry or in oil, $13.25; Red, dry, $13.25; Red, in oil, $14.75.

CHEMICALS—Water and sewage treatment chemicals, round lots in the New York market:

Sulphate of aluminum, iron free, in bags, per 100 lb	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb	5.50@5.60
Soda ash, 58%, in bags, per 100 lb	1.32@1.35
Chlorine, liquid, cylinders, per lb	.05@.08
Bleaching powder, in drums, f.o.b. works, per 100 lb	2.00@2.10

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ¾-in., 8-ft.; ⅞-in., 6-ft.; 1-in., 4½-ft.; 1¼-in., 3½-ft.; 1½-in., 2-ft., 10-in.; 1¾ in., 2-ft. 4 in. Following are prices per pound for ¾-in. and larger, delivered in 1,200-ft. coils:

Atlanta	$0.25	Kansas City	$0.29
Baltimore	.22½	Los Angeles	.25
Birmingham	*.26*	Minneapolis	.22
Boston	.25	Montreal	.24½
Chicago	.20	New Orleans	.23½
Cincinnati	.21	New York	*.21*
Cleveland	*.21*	Philadelphia	.24
Dallas	.20	San Francisco	.20½
Denver	.23	Seattle	*.20½*
Detroit	.24½	St. Louis	.19½

ROOFING MATERIALS—Prices, f.o.b., New York, to contractors in carloads:

Asphalt felt, per 100 lb	$3.50
Tar felt, per 100 lb	3.27½
Asphalt coating, per gal	.40
Tar pitch, in 350 lb. barrels, per ton	31.00

PREPARED ROOFINGS—Prices to contractors, in carloads, f.o.b., New York per square:

Single shingles, slate finish, sufficient to cover 100 sq.ft.	$6.12½
Strip shingles, 4 in 1, hexagonal shape, with Underwriters' label	5.00
Slate surfaced roofing in rolls weighing 85 to 90 lbs.	2.50

WINDOW GLASS—United inches 25, bracket size 6x8 to 10x15, single or double thickness, discount from jobbers' list (Sept. 15, 1928), at New York warehouses:

AA 83% A 86% B 88%

EXPLOSIVES—Prices per pound for dynamite delivered in small lots:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.22	$0.245	Los Angeles, f.o.b.†	$0.1875	$0.2225
Baltimore	.215	.2375	Minneapolis	.1967	.2173
Birmingham	.22	.245	Montreal	.195	.22
Boston	*.245*	*.26*	New Orleans	.235	.26
Chicago	.195*	.22*	New York	.26‡	.2825‡
Cincinnati	.22	.245	Philadelphia	.215	.24
Dallas	.24	.29	St. Louis	.215	.235
Denver, f.o.b.	.1925	.215	San Francisco	.1625	.1925
Kansas City, Mo.	.2025	.2225	Seattle	.16	.185

*Quantities above 500 lb. but less than a ton. †San Fernando Arsenal. ‡Special gelatin in case lots.

Lumber

Prices Are Per Thousand Feet, Board Measure

San Francisco—Prices are for rough Douglas fir, No. 1 common, at yards; for delivery to contractor at site of job, add $1.50 to $5 per M. ft.:

	10-16-18 and 20 Ft. No. 1 Douglas Fir	22 and 24 Ft. No. 1 Douglas Fir
3x3 and 4	$28.00	$29.00
3x6 and 8	28.00	29.00
3x10 and 12	28.00	29.00
3x14	31.00	33.00

Chicago—Prices are f.o.b., in carloads, per M. ft. b.m.; for delivery to job from stock, in truckloads, add $10 per M. ft.:

	20 Ft. and Under No. 1 Long-Leaf Yellow Pine	Up to 32 Ft. No. 1 Douglas Fir
3x4 to 8x8	$40.00	$42.00
3x10 to 10x10	48.50	42.00
3x12 to 12x12	53.50	42.00
3x14 to 14x14	70.50	43.00

New York—Prices per M. ft., b.m., wholesale, for rough, long-leaf, yellow-pine timbers in quantities of 35,000 ft. or more, within lighterage limits:

	20 Ft. and Under Long-Leaf Yellow Pine	22-24 Ft. Long-Leaf Yellow Pine
3x4 to 8x8	$43.00@$45.00	$44.00@$46.00
3x10 to 10x10	50.00@52.00	51.00@55.00
3x12 to 12x12	57.00@59.00	58.00@60.00
3x14 to 14x14	65.00@67.00	66.00@68.00

Other Cities—Prices delivered per M.ft., b.m.:

	8x8-In. x 20 Ft. and Under, Rough				3x12 to 12x12-In. 20 Ft. and Under, Rough	
	Pine*	Fir†	Hemlock	Spruce	Pine*	Fir†
Atlanta	$45.00	.....	.....	.....	$65.00	.....
Baltimore	36.00	$50.25	$54.00	*861.00*	75.00	*$50.00*
Birmingham	45.00	.....	.....	.....	60.00	.....
Boston	48.00	47.00	47.25	*48.00*	56.00	50.00
Cincinnati	38.00	49.00	47.00	47.00	42.00	53.00
Cleveland	65.00	65.00	.....	.....	65.00	65.00
Dallas	57.50	*56.00*	.....	.....	57.50	*56.00*
Denver	.....	59.00	.....	.....	57.00	55.00
Detroit	65.00	55.00	.....	.....	67.50	55.00
Kansas City, Mo.	42.80	*39.75*	.....	.....	57.50	*39.75*
Los Angeles	.....	44.00	.....	.....	.....	44.00
Minneapolis	54.00	49.25	36.25‡	.....	54@56	49.25@50.75
Montreal	50.00	55.00	.....	.....	49.00	48.00
New Orleans	50.00	47.00	.....	44.00	67.00	64.00
Philadelphia	52.00	35.00	42.00	40.00	55.00	35.00
St. Louis	46.00	39.00	.....	.....	55.00	40.50
Seattle	.....	*22.50*	.....	.....	.....	22.50

	1x10 In. x 16 Ft. and Under, Rough			2x10 In. x 16 Ft. T. & Gr.	
	Pine*	Fir†	Hemlock	Pine*	Fir†
Atlanta	$60.00	.....	.....	$47.50	.....
Baltimore	56.00	$45.00	$45.00	35.00	$48.00
Birmingham	36.00	.....	.....	*43.00*	.....
Boston	44.00	42.75	*42.00*	48.00	47.50
Cincinnati	35.00	40.00	33.00	35.00	48.00
Cleveland	60.00	55.00	.....	65.00	58.00
Dallas	.....	.....	.....	57.50	.....
Denver	.....	50.00	.....	.....	51.00
Detroit	42.00	42.00	.....	40.00	50.00
Kansas City, Mo.	*50.50*	45.75	.....	44.75	36.75
Los Angeles	.....	38.00	.....	.....	57.00
Minneapolis	49.00	43.00	38.75	49.00	44.00
Montreal	45.00	48.00	40.00	85.00	70.00
New Orleans	48.00	45.00	.....	50.00	50.00
Philadelphia	55.00	36.50	36.00	52.00	36.50
St. Louis	42.50	39.00	38.00	38.00	35.00
Seattle	.....	*20.00*	.....	.....	*22.00*

*Long-leaf yellow pine. †Douglas fir. ‡F.o.b.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b., New York:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41